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ABSTRACT

This manual contains a group of lesson plans designed for use with a slide series (not included here). Its purpose is to introduce students to the basic concepts and terminology used in the identification of deciduous trees and shrubs. The manual is composed of 12 lesson plans. The first lesson is an introduction to plant identification. The remaining lessons are grouped into three units. Unit 1, Year-Round Identification, contains four lessons: general appearance of a plant as an aid to identification; bark characteristics; stem characteristics; and using year-round identification characteristics to identify plants. Unit 2, Spring and Summer Identification, has four lessons: leaf characteristics; flower characteristics; fruit characteristics; and using year-round and spring and summer identification characteristics to identify plants. Unit 3, Winter Identification, has three lessons: using persistent leaves, flower structures, and persistent fruit for plant identification in winter; bud characteristics; and using year-round and winter identification characteristics to identify plants. Each lesson contains some or all of these components: objectives, resources/materials, terms to learn, procedures, activities, evaluation, plant lists, and handouts. Handouts include outlines of material covered in each unit, illustrations, and worksheets. A glossary is appended. (YLB)

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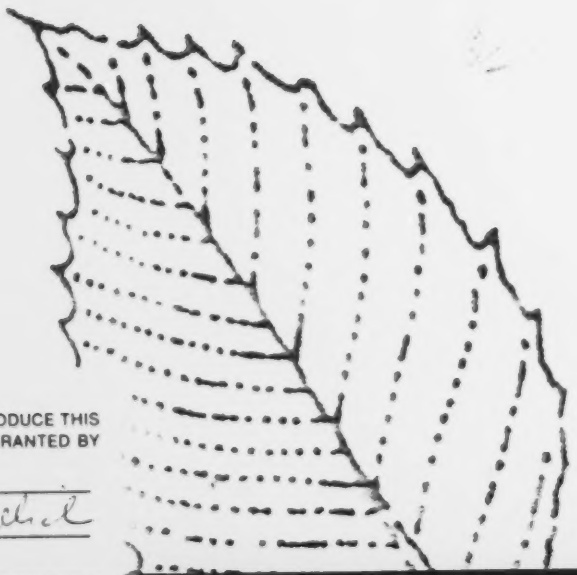
ED 391 958

LESSON PLANS

Plant Identification Characteristics for Deciduous Trees & Shrubs

KATHY BURKHOLDER



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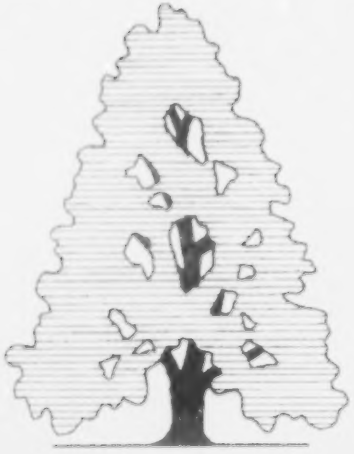
Lesson Plans

for

Plant Identification Characteristics for Deciduous Trees and Shrubs



Kathy Burkholder

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PREFACE

Purpose

This group of lesson plans is designed for use with the slide series *Plant Identification Characteristics for Deciduous Trees and Shrubs.* Its purpose is to introduce students to the basic concepts and terminology used in the identification of deciduous trees and shrubs. Rather than focus on memorizing specific traits of individual plant species, a holistic approach is used, teaching students to observe and appreciate plants in their totality.

This slide series provides introductory information that we hope will help students in ***overall*** plant identification, not identification by leaves alone. More specific plant species information is available in the following slide series from the Ohio Agricultural Education Curriculum Materials Service:

Deciduous Trees
Ornamental Flowering Deciduous Trees
Narrow-Leaved Evergreens
Broad-Leaved Evergreens
Deciduous Shrubs and Vines
Trees Adapted for Use in Cities and Towns
Selected Landscape Plants

Plant Nomenclature

Both common and scientific names are given for all plant species used in this series. The scientific names used are from the *Manual of Woody Landscape Plants,* Fourth Edition, by Michael A. Dirr.

Before beginning the slide series, students should know the importance of scientific names. They should be introduced to the concepts of plant species, cultivars, and varieties.

Lesson Titles

This manual is composed of twelve lesson plans.

Lesson 1: Introduction to Plant Identification

This lesson can precede any of the three units. ***It should be taught first*** regardless of which unit is studied first. The remaining eleven lessons are grouped into three units, as follows:

UNIT 1 YEAR-ROUND IDENTIFICATION
(identification techniques which are useful at any time of year)

Lesson 2: General Appearance of a Plant as an Aid to Identification Year-Round
Lesson 3: Bark Characteristics Useful in Plant Identification Year-Round
Lesson 4: Stem Characteristics Useful in Plant Identification Year-Round
Lesson 5: Using Year-Round Identification Characteristics to Identify Plants

UNIT 2 SPRING & SUMMER IDENTIFICATION

Lesson 6: Leaf Characteristics Useful in Spring and Summer Plant Identification
Lesson 7: Flower Characteristics Useful in Spring and Summer Plant Identification
Lesson 8: Fruit Characteristics Useful in Summer and Fall Plant Identification
Lesson 9: Using Year-Round and Spring & Summer Identification Characteristics to Identify Plants

UNIT 3 WINTER IDENTIFICATION

Lesson 10: Using Persistent Leaves, Flower Structures, and Persistent Fruit for Plant Identification in Winter
Lesson 11: Bud Characteristics Useful in Plant Identification in Winter
Lesson 12: Using Year-Round and Winter Identification Characteristics to Identify Plants

Each of the three "seasonal" sections can be taught independent of the other two. But *Year-Round Identification* should be taught before either *Summer Identification* or *Winter Identification* because of the basic material it contains.

Lesson Contents

Objectives - a list of performance objectives you can expect your students to achieve by lesson completion.

Resources/Materials - a list of resources or materials you will need to teach each lesson. The number in parentheses following a certain material is the number of the Activity for which you will need that material or resource.

Terms to Learn - the plant identification terms introduced in the lesson. Add your own as needed. A glossary is included at the end of this manual. It can be photocopied and distributed to the students.

Procedures - easy to follow and basic to teaching the lesson. A brief outline of information discussed in the slides is included as a preview.

Activities - A numbered list of activities is included to supplement information provided in the slides. There are such suggestions as field trips and guest lecturers, in-class activities for students individually or in groups, and possible homework assignments. The resources and materials listed tie in with these activities. You are encouraged to choose any or all of the activities that will fit best into your teaching program.

Evaluation - At the end of each lesson is a Review that could be given as a test to evaluate the students' progress. There are also some objective quizzes, crossword puzzles, and word searches. At the end of each section (Lessons 5, 9, and 12), you will find a more comprehensive exam covering the entire section. Answer keys are provided for all tests. Suggestions are also included for oral evaluation and other evaluation methods.

Plant Lists - Lists of plants that illustrate the characteristics discussed are included as a convenience. They are not exhaustive lists, but can serve as a starting point in hands-on identification.

Handouts conclude each lesson. They can be copied for each student and handed out. Students who keep handouts in their notebooks will find them useful for review purposes. In some cases, handouts can also be used as transparencies for teaching purposes. The three types of handouts are:

Outline of Material Covered in Unit- located in first lesson in each unit.

Illustrations that can be used as in-class work exercises, as overhead transparencies, and/or in testing (where blanks can be filled with the appropriate terms).

Worksheets - located in final lesson in each unit. Students can actually practice plant identification techniques studied in the lesson and record their findings. Complete directions are provided.

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LESSON 1

Introduction to Plant Identification

Objectives

At the end of this lesson, students should be able to

1. give reasons for the importance of woody plant identification as a basic skill for anyone working in the landscape, garden center, or nursery industry.
2. describe differences between deciduous and evergreen plant species.

Resources/Materials

- slide projector and **slides 1-7**
- guest speaker (1)
- field trip site, arrangements made (2)
- reference materials on pruning, transplanting, and plant diagnostics (3)
- reference materials on pest control and the use of pesticides (4)
- reference materials on landscape design (5)
- twig specimens of deciduous and evergreen plant species for identification (6) or evaluation

Terms to Learn

- deciduous
- evergreen

Procedures

Lesson 1 introduces students to plant identification. This lesson is designed to precede any of the three units of the slide series. It should be the first lesson taught, regardless of which unit is presented first.

- Interest Approach - described in detail on pages 2-5. Developed for students who will be entering occupations which require good plant identification skills. With the use of leading questions, students can be helped to recognize the need for good plant identification skills. Students are also encouraged to participate actively in the lesson.
  Activities 1-5, given on page 6, tie in with this Interest Approach.

Procedures - *continued*

- Teach students the difference between deciduous and evergreen plant species. Tell students that they will soon begin learning how to identify deciduous trees and shrubs.
- Perform Activities 6 and 7 if desired.
- Follow this lesson with Unit 1, Unit 2, or Unit 3.

Interest Approach

You can address the following three questions with students who are planning to enter occupations requiring tree and shrub identification skills.

1. Why do you need good plant identification skills?
2. What problems have you had with plant identification?
3. What do you need to know to correct these problems?

You will find possible student responses to each of these questions in the following pages. These responses relate to the nursery/landscape/ horticulture industry. If you are teaching in a related field, you can also have students develop appropriate responses for their occupational areas.

Encourage students to keep a notebook for these questions and answers. Have them leave extra space after each question for additional answers they can add later.

QUESTION 1 *(on the board)*

"Why do you need good plant identification skills?"

Encourage students to think of answers to this question. Write their responses on the board. Have students write the question and responses in their notebooks.

Students are unlikely to develop a complete list of answers right away. Provide them with supervised study opportunities so they can further investigate the problem area. Activities 1-5 will help accomplish this. When these activities are completed, have the students continue to add reasons to the lists in their notebooks.

As you teach these three units, keep the importance of good plant identification skills always in the students' minds. Encourage them to add reasons to their lists as they think of them. One activity or more of Activities 1-5 can be introduced at a later point while you are teaching Lessons 2-12.

Note: First, point out the mistake some students make of relying on name labels to identify plants. Frequently labels get lost or become unreadable from fading due to weathering. Sometimes a label gets attached to the wrong plant, and sometimes the name on a label is incorrect.

Following are some responses you might explore with your students to help them understand the value of good plant identification skills.

Being able to identify plants

1. helps you answer customer questions about a particular plant in the nursery or landscape. Customers may want to know about the plant's size and shape, its cultural requirements, and any ornamental features such as flowers, fruit, and fall color.

2. enables you to recommend plants to a customer. For example, if a customer wants a low-growing shrub with attractive flowers and one which does well in a shady site, you can make a suggestion.

3. helps you as a landscape worker to correctly identify a tree in a client's yard. This will increase the client's confidence in your professional ability. Also, you will be better prepared to care for the plant properly.

4. helps you to verify that the correct plants were shipped, when you receive a shipment of trees and shrubs from a nursery.

5. allows you to follow your supervisor's directions accurately. For example, your supervisor asks you to go to a client's home and prune the crabapples and mulch the spireas. Or in the nursery your supervisor asks you to water the Japanese maples and bring three cranberry cotoneasters to the cash register for a customer. How can you complete these tasks without being able to identify the plants mentioned?

6. will help you determine both the best time of year to prune a plant and how best to prune it to prevent misshaping and to assure plant health.

7. helps you transplant plants appropriately.

   - You can determine the best time of year to transplant a given plant into the landscape. Trees and shrubs transplanted at their "wrong" time of year may perform poorly.

   - You can determine how best to handle a given plant when transplanting it. Some plants are easy to transplant. Others are more difficult.

8. and knowing their characteristics allows you to choose the "right" plants to use in a landscape design. To select and place the appropriate plant successfully in the landscape, you will need to know the following information about the plant:

   - size and shape
   - cultural requirements
   - hardiness
   - pest resistance
   - ornamental features

9. gives you as a landscape designer the ability to visit a site before the design work begins. You will be able to determine what plants are currently on the site and to recommend which plants should be kept and which removed.

10. is very important in plant diagnostics. As a nursery employee, you will be able to deal appropriately with a customer who shows you a plant in poor health and asks you to determine what is wrong. When you know the identity of the plant, you should then be better able to determine whether the plant

    - was planted in the wrong site for its needs,
    - is suffering from nutrient deficiencies, or
    - has an insect or disease problem.

11. is critical in practicing pest control. You will be asked to determine the following:

    - What pest is attacking the plant?
    - What is the best control measure for dealing with this pest?
    - What pesticide is best to use for this problem?
    - Can I legally apply it?
    - Is it harmful to this plant?

    You must know what plant you are dealing with. A wrong diagnosis or choice can be very costly.

12. may enable you to determine why an ornamental flowering tree or shrub sometimes fails to produce flowers or why an ornamental fruit tree fails to produce fruit.

QUESTION 2

"What problems have you run into with plant identification?"

Ask students to think back to such experiences as gathering leaves for leaf collections for a science class. Find out whether they have had any other experience in tree and shrub identification. List student responses to the question on the board. Encourage the students to write both question and answers in their notebooks.

Following are some 'problem' responses:

1. Leaves of many different kinds of trees are similar. It's hard to tell them apart.
2. Some trees have branches with leaves too high off the ground to reach them.
3. There are no leaves on the plant in the winter.
4. It's easiest to identify certain plants by their flowers. How can I identify the plant when its flowers are not present?
5. I can identify a few common trees, but shrubs are hard to identify.
6. A few trees are easy to identify by their special characteristics, such as the shaggy bark of shagbark hickory. Otherwise, most trees look alike to me.
7. Trees that are closely related are hard to tell apart. For example, I know that there are several kinds of maples. How do you tell them apart?
8. Where can I find a good variety of trees and shrubs to identify? There are only a few kinds of trees on my street. I'm afraid I'll get into trouble if I take leaves from the trees in parks.
9. I've had trouble identifying plants using reference books. The descriptions of trees in them are hard to understand.
10. What are some good books to use to help identify plants?

QUESTION 3

"What do you need to know to correct these problems?"

Ask students to supply answers. Again, have them write the question and answers in their notebooks. Following are some possible responses:

1. Methods for identifying trees and shrubs without using leaves and flowers
2. Methods for identifying trees and shrubs in winter
3. How to tell apart leaves from different species of trees
4. The meaning of words used in reference books
5. The titles of books that would be helpful with identification

Following the last question, you are ready to take the students into the **slide series** with presentation of **slides 1-7**.

Activities

1. Invite a former student or an industry employee to speak to the class. Have this person discuss ways in which he or she uses plant identification skills on a daily basis.

2. Arrange for a field trip to a garden center or nursery. Have an employee illustrate to students the need for good identification skills on the job.

3. Bring to class reference materials on the installation and maintenance of plants, including pruning, transplanting, and plant diagnostics. Ask students to review the materials, looking for ways that plant identification skills are necessary to perform certain jobs.

4. Bring to class reference materials on pest control. Good sources of information include University Extension Service spray guides and certain pesticide labels that specify which plant species to use the pesticide on. Ask students to review the materials, looking for ways that plant identification aids in pest control.

5. Have students practice designing a landscape for an area outside the school. Have them list ways that familiarity with plants and their characteristics will help in the selection of plants for the site. Provide design reference materials, if necessary.

6. Take students outdoors to look at both deciduous and evergreen plant species. Or bring cut-twig examples of each into the classroom.

7. Have students perform an inventory of trees and shrubs at a certain site: at their homes, on the school property, or at a nearby park. Have students determine which plants are deciduous and which are evergreen. Ask students whether they can identify any of the plant species. Have students pretend that they are responsible for caring for these trees and shrubs. Ask students to list ways that knowing the plants' identities can help them care for the plants properly.

Evaluation

If you had the class do Activity 6 or 7, have students correctly identify different deciduous and evergreen species. Bring specimens into class or take the students outdoors.

LESSON 2

General Appearance of a Plant as an Aid to Identification Year-Round

Objectives

At the end of this lesson, students should be able to

1. explain the importance of being able to identify plants by means other than leaves.
2. use plant size as an identification tool.
3. describe six basic plant shapes.
4. identify major types of trunk habits.
5. define plant texture and its use in plant identification.

Resources/Materials

- slide projector and **slides 8-36**
- overhead projector
- **graphic 2-1** as an overhead transparency
- photocopies of the evaluation page **General Appearance Review**
- photocopies of the handout **Year-Round Identification Outline**
- overhead transparencies and/or photocopies of **graphics 2-2, 2-3, 2-4, 2-5**
- reference materials describing the influence of plant size in landscape considerations (1)
- pictures of plants that were improperly placed in the landscape for their size (1)
- magazines and nursery catalogs containing pictures of trees and shrubs (2)
- three twigs illustrating fine, medium, and coarse textures (3)

Terms to Learn

- columnar growth habit
- pyramidal growth habit
- rounded growth habit
- oval growth habit
- vase-shaped growth habit
- weeping growth habit
- trunk habit
- texture

Procedures

1. Introduction (Interest Approach)

   ✢ Ask students whether they believe it is possible to identify plants by means other than leaves. Lead them further to explain why it is important to do so. Show **graphic 2-1, Plants Have Their Differences** (page 13) as an overhead transparency. Ask students to list differences in appearance between the two plants.

   ✢ Introduce the topic of Year-Round Identification, involving plant identification features that are present at all times of the year. Give students the **Year-Round Identification Outline** (page 12) to put in their notebooks. Explain that the class will be studying these plant characteristics together.

2. Show slides 8-26 - General Appearance *(first part)*.

   ❍ Size of trees and shrubs

   ❍ Shape - the six basic plant shapes:

columnar	oval
pyramidal	vase-shaped
rounded	weeping

3. Have students work with **graphics 2-2, Plant Size** and **2-3, Plant Shape**.

4. Use Activities 1 and 2 if desired.

5. Show slides 27-36 - General Appearance *(second part)*.

   ❍ Trunk habit - single versus multiple trunks

   ❍ Texture
   * coarse, medium, and fine texture
   * texture in appearance of trees in summer and winter

6. Have students work with **graphics 2-4, Trunk Habit** and **2-5, Plant Texture**.

7. Discuss with students the differences between a ***tree*** and a ***shrub*** (size and trunk habit considerations).

8. Use Activities 3, 4, and 5 if desired.

9. Evaluate student learning.

Activities

1. Write the following question on the board:

How does the size of a plant affect its placement in the landscape?

Divide students into groups to answer this question. If necessary, provide reference materials and allow students to research the question using supervised study. When students have finished, list their responses on the board. Following are some possible responses, which can be further developed. Stress the practical aspects of plant size.

- Scale
  Plants should be in scale with the house and the rest of the landscape. Small and medium-sized trees look best in small residential lots; large trees are better suited for parks and large open areas. (Example of tree out of scale: a very large spruce tree growing up against a one-story house on a small residential lot.) If possible, show students pictures of trees that are out of scale with the house.

- Mature plant size
  Plants installed around the foundation of a house should be selected with concern for their mature size. Homeowners frequently buy small "cute" shrubs at a garden center, only to discover that in ten years those shrubs have become monsters, overgrowing windows, doors, walks, and driveways.

- Hedge use and size
  Plant size is a consideration for hedges or screens used in the landscape. A homeowner may want a 3-foot-tall hedge to keep the neighbor's dog out of the yard. Or the homeowner may want a 15-foot-tall hedge for privacy in the yard or to serve as a windbreak. When selecting plants for a hedge, the homeowner must consider the plants' mature height.

- Plants and utility lines
  Plant size is a very important consideration when selecting trees that will be growing under utility lines. Small-sized trees that will not grow into the lines are needed. Trees that do grow into utility lines are often topped, losing their natural beauty and even their health. Show students pictures of large trees that have been topped because they are under power lines.

- Plants along streets
  Plant size is a consideration when selecting trees and shrubs for use in street median strips, at street intersections, and along streets and sidewalks. These plants must not obstruct the vision of drivers, overgrow sidewalks, or interfere with pedestrian traffic. Size and shape are both concerns. Typically, wide-spreading trees and shrubs are not desirable.

Activities - *continued*

2. Ask the students to cut pictures of trees and shrubs from magazines and a nursery catalog, showing different shapes. Have the students identify each plant pictured and label it. Assemble these pictures on a bulletin board, or have students keep their own collections in their notebooks. Point out to students not only the six basic shapes studied in this unit, but the wide variety of shapes and forms that are found in trees and shrubs.

3. Bring to class three different twigs illustrating fine, medium, and coarse textures. In winter, concentrate on twigs. In summer, concentrate on foliage.

4. Take students outside and look at various trees and shrubs. Evaluate the plants in terms of their size, shape, trunk habit, and texture.

5. In a horticulture class on landscape design, point out the importance of a plant's size, shape, trunk habit, and texture in the plant's placement in the landscape and in the overall landscape design.

Evaluation

✢ Hand out photocopies of General Appearance Review (page 11) with the drawing of a tree.

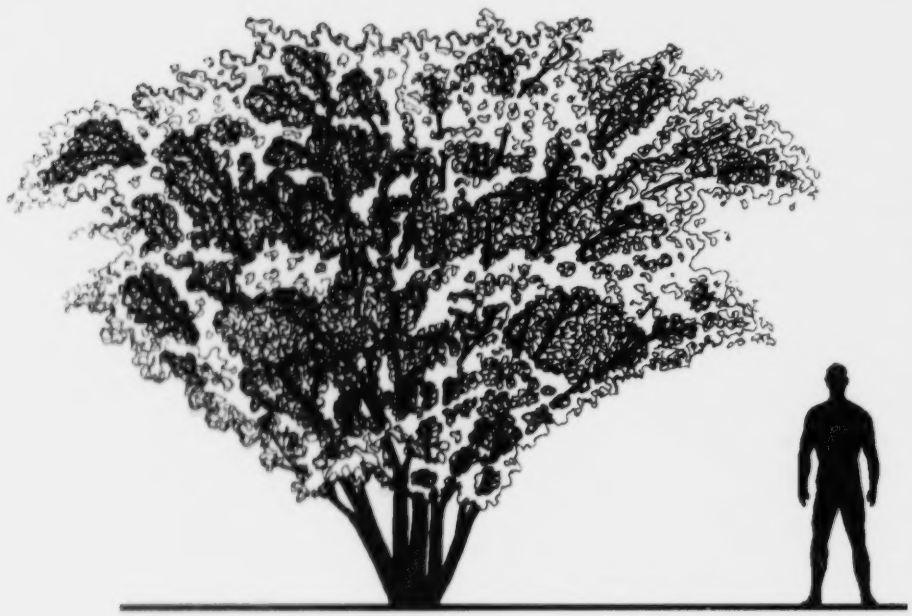
Answer: The plant is a tree, small in size, fine in texture, with multiple trunks and a vase-shaped growth habit.

✢ Bring three new cut twigs to class illustrating fine, medium, and coarse textures. Ask students to identify which twig has which texture.

NAME _____

General Appearance
REVIEW

This plant has several characteristics that can be used to help identify it. Describe three of these characteristics on the lines below.



1 _____

2 _____

3 _____

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Year-Round Identification Outline

I **General Appearance**

A. Size

B. Shape
   1. columnar
   2. pyramidal
   3. rounded
   4. oval
   5. vase-shaped
   6. weeping

C. Trunk Habit
   1. single main trunk
   2. multiple main trunks

D. Texture
   1. coarse
   2. medium
   3. fine

II **Bark Characteristics**

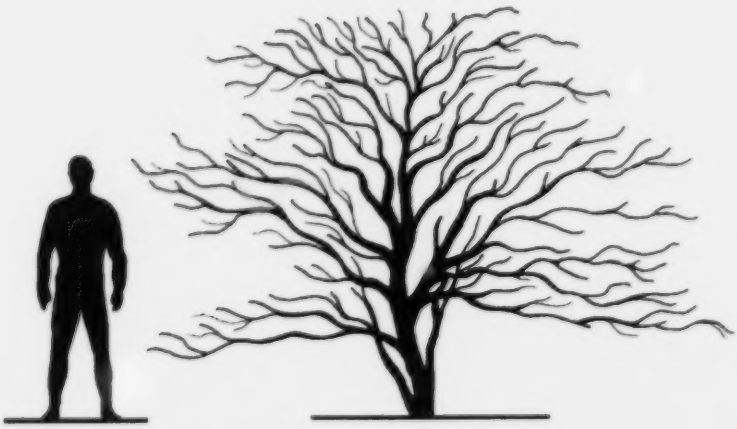
A. Color
B. Peeling (Exfoliation)
C. Unique patterns and textures

III **Stem Characteristics**

A. Color
B. Shape
C. Pubescence
D. Odor
E. Thorns or spines
F. Lenticels
G. Leaf scars
H. Pith

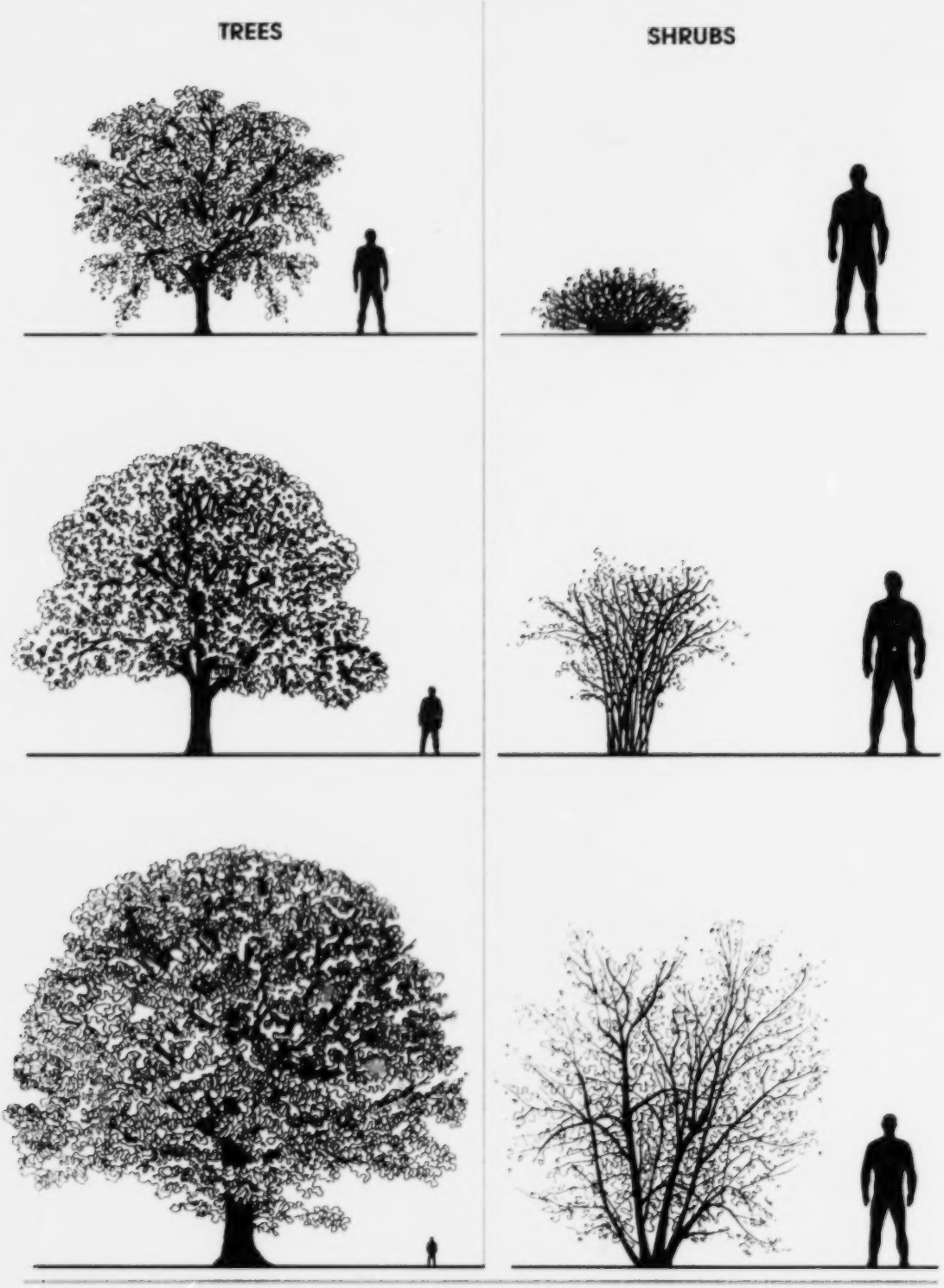
Graphic 2-1

Plants Have Their Differences



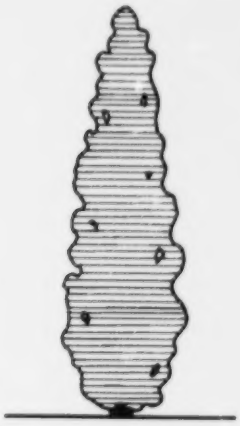
Graphic 2-2

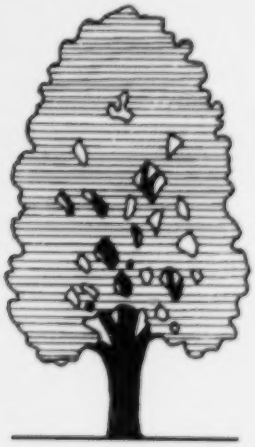
Plant Size

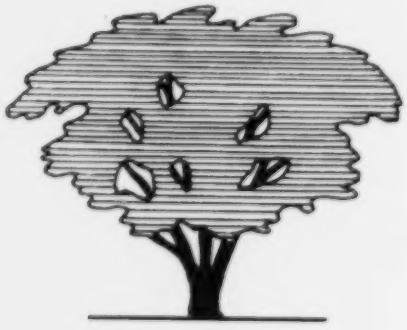


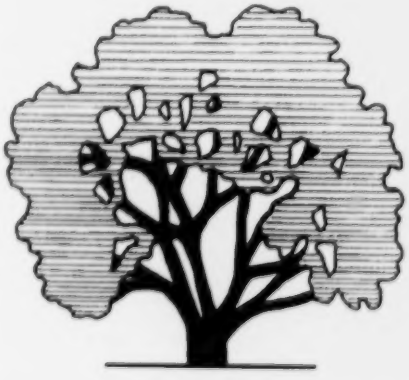
Graphic 2-3

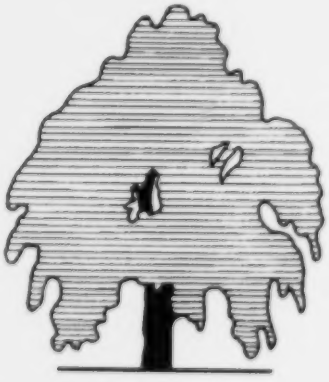
Plant Shape





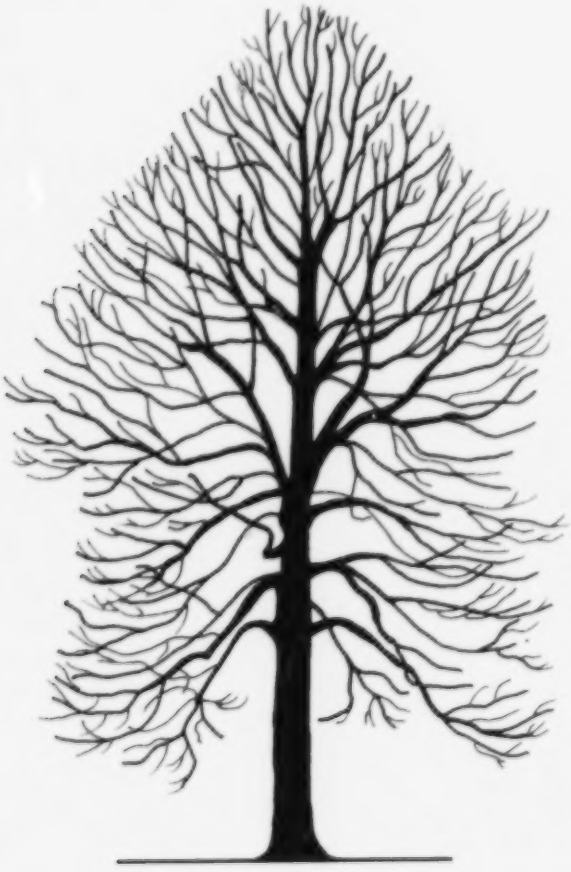






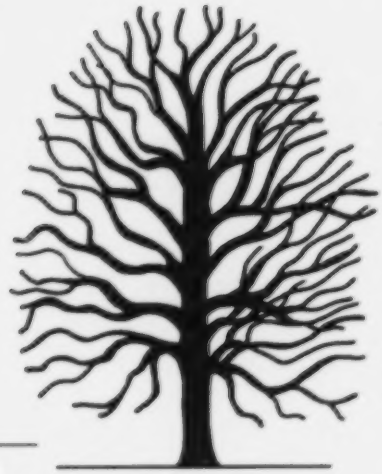
Graphic 2-4

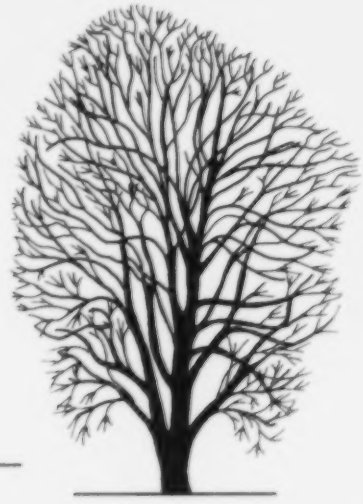
Trunk Habit

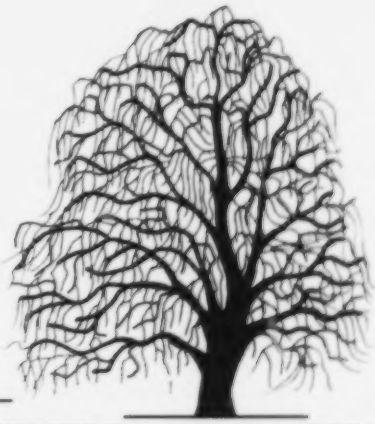


Graphic 2-5

Plant Texture







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LESSON 3
Bark Characteristics Useful in Plant Identification Year-Round

Objectives

At the end of this lesson, students should be able to

1. describe the variations in bark color among plant species and how to use these variations in plant identification.
2. define exfoliation and explain its use in plant identification.
3. evaluate bark for unique patterns and textures as an aid to identification.

Resources/Materials

- slide projector and **slides 37-48**
- photocopies of the evaluation page **Word Search Puzzle**
- pictures of trees and shrubs with unusual bark (1)
- reference texts with descriptions of plant species (2,3)

Term to Learn

- exfoliate

Procedures

1. Review material from the previous lesson and introduce the topic.
2. Show slides 37-48 - Bark Characteristics.
   - Color
   - Peeling
   - Unique patterns and textures - plants with bark that has special identifying characteristics such as lines, ridges, stripes, etc.
3. Perform the activities suggested.
4. Evaluate student learning.

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Activities

1. Point out that bark contributes greatly to the beauty of certain plant species. Ornamental bark is particularly attractive in winter when other ornamental features such as foliage and flowers are not present. Display pictures of plants with outstanding ornamental bark, such as the following species:

   paperbark maple *(Acer griseum)*
   Kousa dogwood *(Cornus kousa)*
   sycamore and London planetree *(Platanus)*
   lacebark elm *(Ulmus parvifolia)*
   oakleaf hydrangea *(Hydrangea quercifolia)*
   Persian parrotia *(Parrotia persica)*

   and representatives of the following genera:

   serviceberry *(Amelanchier)*
   beech *(Fagus)*
   birch *(Betula)*
   stewartia *(Stewartia)*
   red-stemmed dogwoods *(Cornus)*

2. Take students outside and divide them into groups. Assign each group one or two trees and shrubs with unusual bark. Have each group describe the plants' bark in writing. Then tell students the names of their plants and have them read about the plants in a reference text.

3. Assign each student a deciduous tree or shrub with ornamental bark. Have students research their plants, briefly describing the plant's size, shape, trunk habit, texture, and bark. Ask each student how this plant can be used in the landscape. Students could then report their findings to the class. Supply reference texts.

Evaluation

Answer Key to
Bark Characteristics
Word Search Puzzle
(page 21)

A	P	S	D	F	O	S	H	A	G	G	Y	N	B	A	A
S	E	S	M	O	O	T	H	S	E	P	E	R	N	E	S
K	N	U	I	I	O	T	O	Q	U	A	T	Y	G	H	T
R	S	L	S	S	B	W	N	B	A	P	L	N	C	O	R
A	M	U	D	E	E	J	G	L	N	E	A	R	U	L	D
B	Z	L	F	R	X	R	W	O	Z	R	I	W	R	A	E
L	N	D	A	V	F	T	Q	T	D	B	L	S	L	C	R
A	P	G	Y	I	O	I	P	Y	H	A	T	R	I	E	O
T	C	T	N	C	L	A	H	H	U	R	S	X	N	B	L
N	R	O	D	E	I	F	C	F	I	K	W	U	G	A	O
E	R	E	C	B	A	B	E	P	N	M	I	N	O	R	C
M	O	R	A	E	T	L	E	S	G	A	P	G	I	K	I
A	G	I	L	R	E	D	B	W	L	P	J	D	G	E	T
N	Y	K	P	R	I	U	Y	T	R	L	G	Q	M	L	L
R	A	C	S	Y	C	A	M	O	R	E	D	S	A	M	U
O	I	U	Y	T	R	E	W	Q	D	N	B	V	C	X	M

LESSON 3
Bark Characteristics Useful in Plant Identification Year-Round

Objectives

At the end of this lesson, students should be able to

1. describe the variations in bark color among plant species and how to use these variations in plant identification.
2. define exfoliation and explain its use in plant identification.
3. evaluate bark for unique patterns and textures as an aid to identification.

Resources/Materials

- slide projector and **slides 37-48**
- photocopies of the evaluation page **Word Search Puzzle**
- pictures of trees and shrubs with unusual bark (1)
- reference texts with descriptions of plant species (2,3)

Term to Learn

- exfoliate

Procedures

1. Review material from the previous lesson and introduce the topic.
2. Show slides 37-48 - Bark Characteristics.
   - Color
   - Peeling
   - Unique patterns and textures - plants with bark that has special identifying characteristics such as lines, ridges, stripes, etc.
3. Perform the activities suggested.
4. Evaluate student learning.

Activities

1. Point out that bark contributes greatly to the beauty of certain plant species. Ornamental bark is particularly attractive in winter when other ornamental features such as foliage and flowers are not present. Display pictures of plants with outstanding ornamental bark, such as the following species:

   paperbark maple *(Acer griseum)*
   Kousa dogwood *(Cornus kousa)*
   sycamore and London planetree *(Platanus)*
   lacebark elm *(Ulmus parvifolia)*
   oakleaf hydrangea *(Hydrangea quercifolia)*
   Persian parrotia *(Parrotia persica)*

   and representatives of the following genera:

   serviceberry *(Amelanchier)*
   beech *(Fagus)*
   birch *(Betula)*
   stewartia *(Stewartia)*
   red-stemmed dogwoods *(Cornus)*

2. Take students outside and divide them into groups. Assign each group one or two trees and shrubs with unusual bark. Have each group describe the plants' bark in writing. Then tell students the names of their plants and have them read about the plants in a reference text.

3. Assign each student a deciduous tree or shrub with ornamental bark. Have students research their plants, briefly describing the plant's size, shape, trunk habit, texture, and bark. Ask each student how this plant can be used in the landscape. Students could then report their findings to the class. Supply reference texts.

Evaluation

Answer Key to Bark Characteristics Word Search Puzzle (page 21)

A	P	S	D	F	O	S	H	A	G	G	Y	N	B	A	A
S	E	S	M	O	O	T	H	S	E	P	E	R	N	E	S
K	N	U	I	I	O	T	O	Q	U	A	T	Y	G	H	T
R	S	L	S	S	B	W	N	B	A	P	L	N	C	O	R
A	M	U	D	E	E	J	G	L	N	E	A	R	U	L	D
B	Z	L	F	R	X	R	W	O	Z	R	I	W	R	A	E
L	N	D	A	V	F	T	Q	T	D	B	L	S	L	C	R
A	P	G	Y	I	O	I	P	Y	H	A	T	R	I	E	O
T	C	T	N	C	L	A	H	H	U	R	S	X	N	B	L
N	R	O	D	E	I	F	C	F	I	K	W	U	G	A	O
E	R	E	C	B	A	B	E	P	N	M	I	N	O	R	C
M	O	R	A	E	T	L	E	S	G	A	P	G	I	K	I
A	G	I	L	R	E	D	B	W	L	P	J	D	G	E	T
N	Y	K	P	R	I	U	Y	T	R	L	G	Q	M	L	L
R	A	C	S	Y	C	A	M	O	R	E	D	S	A	M	U
O	I	U	Y	T	R	E	W	Q	D	N	B	V	C	X	M

NAME _____

Bark Characteristics
Word Search Puzzle

Several kinds of ornamental bark and some of the plants that possess them are listed at the bottom of the page. Find each word in the puzzle below and circle it. The letters can run up or down, forwards or backwards, or diagonally. Two-word names and terms are run together into one. *Example:* ORNAMENTAL BARK

A P S D F O S H A G G Y N B A A
S E S M O O T H S E P E R N E S
K N U I I O T O Q U A T Y G H T
R S L S S B W N B A P L N C O R
A M U D E E J G L N E A R U L D
B Z L F R X R W O Z R I W R A E
L N D A V F T Q T D B L S L C R
A P G Y I O I P Y H A T R I E O
T C T N C L A H H U R S X N B L
N R O D E I F C F I K W U G A O
E R E C B A B E P N M I N O R C
M O R A E T L E S G A P G I K I
A G I L R E D B W L P J D G E T
N Y K P R I U Y T R L G Q M L L
R A C S Y C A M O R E D S A M U
O I U Y T R E W Q D N B V C X M

curling
exfoliate
multicolored
ridged
shaggy
smooth
striped

beech
birch
Kousa dogwood
lacebark elm
oakleaf hydrangea
paperbark maple
serviceberry
sycamore

LESSON 4

Stem Characteristics Useful in Plant Identification Year-Round

Objectives

At the end of this lesson, students should be able to

1. list and describe stem characteristics useful in plant identification (color, shape, pubescence, odor, thorns or spines, lenticels, leaf scars, pith).

2. locate lenticels, leaf scars, and pith on twigs.

Resources/Materials

- slide projector and **slides 49-77**
- overhead projector and overhead transparency and/or photocopies of **graphic 4-1**
- photocopies of the evaluation page **Crossword Puzzle**
- twigs illustrating such stem characteristics as color, shape, pubescence, odor, and thorns or spines (1)
- twigs with both pleasant and unpleasant odors (2)
- twigs with prominent lenticels and leaf scars (3)
- twigs with solid, chambered, and hollow pith, and pith of different colors (3)

Terms to Learn

- pubescence
- lenticel
- leaf scar
- pith

Procedures

1. Review material from the previous lesson and introduce the topic.

2. Show slides 49-64 - Stem Characteristics.

Procedures - *continued*

- Color
- Shape
- Pubescence
- Odor - both pleasant and unpleasant
- Thorns or spines

3. Perform Activities 1 and 2 if desired.

4. Show slides 65-77 - More Stem Characteristics - A Closer Look.

   - Lenticels - defined and illustrated
   - Leaf scars - defined and illustrated
   - Pith - solid, chambered, and hollow pith and pith of different colors

5. Hand out copies of **graphic 4-1, Stem Characteristics**.

6. Perform Activities 3 and 4 if desired.

7. Evaluate student learning.

Activities

1. Bring cut twigs to class to serve as examples of the following stem characteristics: color, shape, pubescence, and thorns or spines. Allow students to examine the twigs. Or take students outside and examine twigs for stem characteristics.

   Note: Lists of the more common plant species that possess the distinctive stem characteristics discussed in this lesson are presented on pages 27-29. These lists are not meant to be exhaustive. They are presented primarily to suggest which twig specimens to collect to show students in class.

2. Bring in cut twigs from plant species with stem odors (both pleasant and unpleasant). Allow students to scratch and sniff.

3. Bring in cut twig specimens that show lenticels, leaf scars, and different kinds of pith. Have the students practice identifying and labeling each. Have twigs that demonstrate solid, chambered, and hollowed pith, as well as pith of different colors.

4. Attach to a bulletin board the twigs used in the earlier activities. Name the plant each twig is from and the stem characteristic each one illustrates.

Evaluation

1. The crossword puzzle included in this lesson (page 26) can be photocopied as needed. The answers are:

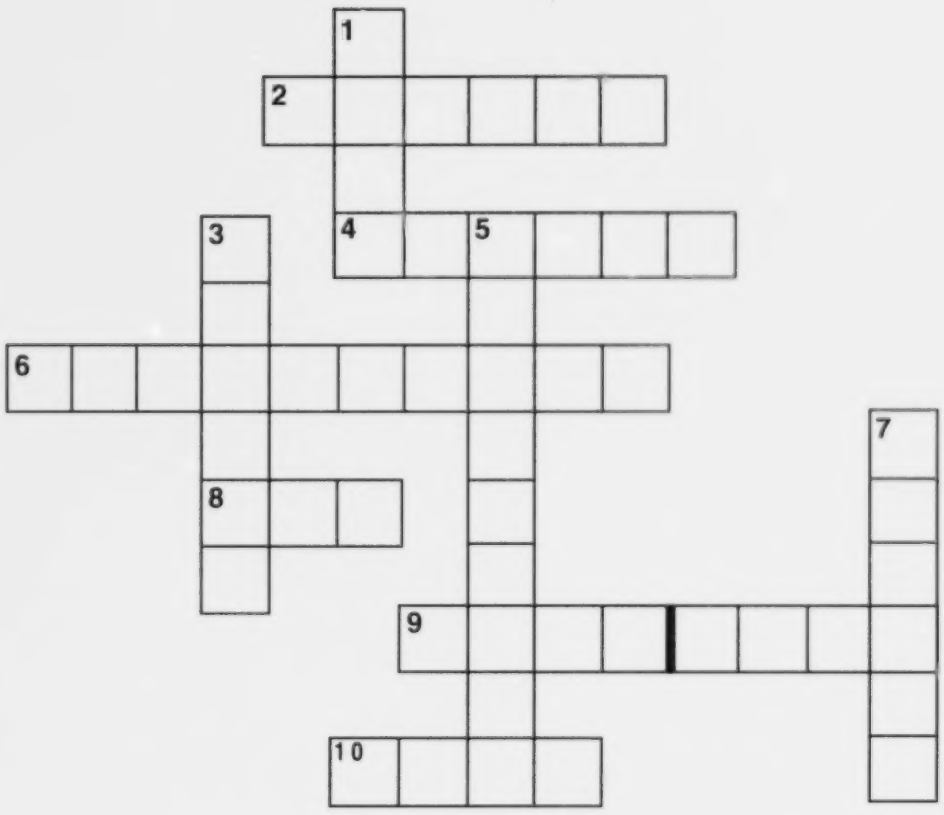
ACROSS	DOWN
2 zigzag	1 pith
4 hollow	3 cherry
6 pubescence	5 lenticels
8 red	7 thorns
9 leaf scar	
10 rose	

2. If you used Activity 3, bring in a twig with prominent lenticels and leaf scars. Have the students locate lenticels, leaf scars, and pith on the twig. Ask the students to describe the pith using the characteristics described in this lesson.

3. If you used Activities 1, 2, and 3, bring into class several twigs that possess particular stem characteristics. Ask the students to describe two or three characteristics of each twig that would be helpful in identification.

NAME _____

Stem Characteristics Crossword Puzzle



ACROSS

2 One kind of stem shape
4 Pith may be solid, chambered, or _____
6 Hair-like covering on some stems
8 Bright stem color easy to see in winter
9 Mark left on twig where leaf was attached *(two words)*
10 Common plant with thorny stems

DOWN

1 Center part of the twig
3 Common tree with horizontal lenticels
5 Corky spots on stems that help identify different plants
7 Slender, sharp objects sometimes found on stems

List of Plants with Distinctive Stem Characteristics

Stem Color (often most noticeable on new growth)

Japanese maple *(Acer palmatum)* - green or red
red-stemmed dogwoods *(Cornus alba, C. sericea)* - purple or red
yellow-twig dogwood *(Cornus sericea* 'Flaviramea') - yellow
several cotoneasters *(Cotoneaster)* - purple stems
winged euonymus *(Euonymus alatus)* - green
Japanese kerria *(Kerria japonica)* - green
sweetbay magnolia *(Magnolia virginiana)* - green
sassafras *(Sassafras albidum)* - green
thornless common honeylocust *(Gleditsia triacanthos* var. *inermis)* - olive brown (especially new growth)
sweet mockorange *(Philadelphus coronarius)* - red or reddish brown
Japanese pagodatree *(Sophora japonica)* - green
some willow species *(Salix)* - yellow, yellowish brown, reddish brown

Stem Shape

Zigzag stems

eastern redbud *(Cercis canadensis)*
fothergilla *(Fothergilla gardenii* and *F. major)*
thornless common honeylocust *(Gleditsia triacanthos* var. *inermis)*
Scotch elm *(Ulmus glabra)*
black locust *(Robinia pseudoacacia)*

Other distinctive stems

sweetshrub *(Calycanthus floridus)* - wider at nodes
winged euonymus *(Euonymus alatus)* - wings protruding from stems
silver maple *(Acer saccharinum)* - tips of stems curling upward
American sweetgum *(Liquidambar styraciflua)* - corky wings protruding from stems

Stem Pubescence

Heavily pubescent stems

staghorn sumac *(Rhus typhina)*
Scotch elm *(Ulmus glabra)*

Many other species with less heavily pubescent stems; may need close examination.

List of Plants with Distinctive Stem Characteristics *(page 2)*

Stem Odor

Pleasant

sassafras *(Sassafras aibidum)*
spicebush *(Lindera benzoin)*
walnut *(Juglans* species)
magnolias *(Magnolia* species)
sweetshrub *(Calycanthus floridus)*
tuliptree *(Liriodendron tulipifera)*
northern bayberry *(Myrica pensylvanica)*

Unpleasant

silver maple *(Acer saccharinum)*
boxelder *(Acer negundo)*
Ohio buckeye *(Aesculus glabra)*
tree of heaven *(Ailanthus altissima)*
smokebush *(Cotinus coggygria)*

Thorns and Spines

scarlet firethorn *(Pyracantha coccinea)*
common honeylocust *(Gleditsia triacanthos)* - not the thornless landscape variety
black locust *(Robinia pseudoacacia)*
blackberries, raspberries, and others *(Rubus)*
barberries *(Berberis)*
hawthorns *(Crataegus)*
roses *(Rosa)*

Distinctive Markings

Distinctive lenticels

northern catalpa *(Catalpa speciosa)*
forsythia *(Forsythia* x *intermedia)*
glossy buckthorn *(Rhamnus frangula)*
Japanese tree lilac *(Syringa reticulata)*
saucer magnolia *(Magnolia* x *soulangiana)*
American elder *(Sambucus canadensis)*

Distinctive leaf scars

Kentucky coffeetree *(Gymnocladus dioicus)*
northern catalpa *(Catalpa speciosa)*
amur corktree *(Phellodendron amurense)*
tree of heaven *(Ailanthus altissima)*
Japanese maple *(Acer palmatum)*

List of Plants with Distinctive Stem Characteristics *(page 3)*

Stem Pith

Hollow

slender deutzia *(Deutzia gracilis)*
several honeysuckles *(Lonicera)*

Chambered

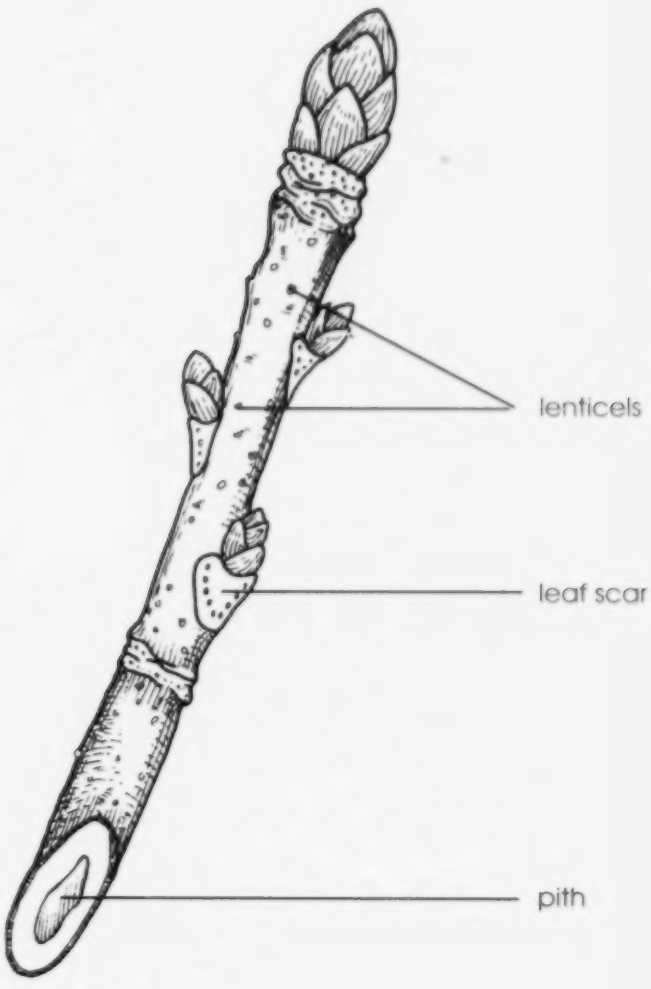
walnut *(Juglans)*
forsythia *(Forsythia* x *intermedia)* - with pith chambered in internodes and solid at nodes

Colored pith

northern catalpa *(Catalpa speciosa)* - white
several shrub-form dogwoods *(Cornus)* - white or brown
sweet mockorange *(Philadelphus coronarius)* - white
American elder *(Sambucus canadensis)* - white or tan
Kentucky coffeetree *(Gymnocladus dioicus)* - orangish brown
staghorn sumac *(Rhus typhina)* - orange to brown
smokebush *(Cotinus coggygria)* - orangish brown
tree of heaven *(Ailanthus altissima)* - tan

Graphic 4-1

Stem Characteristics



38

LESSON 5

Using Year-Round Identification Characteristics to Identify Plants

Objectives

At the end of this lesson, students should be able to

1. evaluate plants using year-round identification characteristics.
2. consult reference texts as an aid to plant identification.

Resources/Materials

- slide projector and **slides 78-82**
- reference texts containing descriptions of plant species
- photocopies of **Year-Round Identification Worksheet**
- photocopies of the evaluation pages - **Year-Round Identification Exam**

Procedures

Summary Lesson for Year-Round Identification Unit

Encourage students to practice identifying plants using the information from Lessons 2-4. Slides 78-82 demonstrate a holistic approach to identification; several identification characteristics are used. After showing the slides, have students practice the technique using real plants.

1. Review with students their list of important reasons for learning plant identification skills from Lesson 1. Reinforce the value of plant identification. Encourage students to add more reasons to their list.

2. Review material from the previous lessons. Make sure students are now ready to practice using year-round identification characteristics to identify unknown plants.

3. Show slides 78-82 - Practice ID.

(continued)

Procedures – continued

4. Bring to class several tree and shrub identification guides and books for students to look through. Use these reference materials for the following exercise.

5. Hand out to each student a copy of the **Year-Round Identification Worksheet**. Divide students into small groups. Assign each group a tree or shrub. Have them complete the worksheet, examining "their" plant for features that are useful in identification. When they have completed the worksheet, tell each group the name of the plant they were assigned. They can then find the plant in a reference book and check how well their findings match the book's descriptions.

   Another approach is to give students a list of plants, including the plant being identified. Have them use the worksheet and reference texts to determine which plant on the list is the one they are actually identifying.

6. Evaluate student learning.

Evaluation

- Give the students photocopies of pages 33 through 36 as an end-of-unit exam. (See Answer Key below.)

- Take students to a live tree or shrub. Have the students make a list of characteristics of the plant that can help identify it. Possible responses include descriptions of its size, shape, trunk habit, texture, bark features, and stem characteristics.

Answer Key to Year-Round Identification Exam

1. a
2. c
3. a
4. d
5. b
6. d
7. Color, shape, pubescence, odor, thorns or spines
10. b
11. a
12. a
13. c
14. The plant has the following characteristics:

single trunk	rounded shape
large size	exfoliating bark
coarse texture	

NAME _____

Year-Round Identification Exam

Circle the letter of the response for each question that best answers the question or completes the statement. *(6 points each)*

1. Deciduous trees and shrubs are best defined as plants that

   a. drop their leaves in the fall.
   b. keep their leaves through the winter.
   c. possess narrow needle-like leaves.
   d. produce flowers and fruit.

2. Which of the following best describes a plant with a columnar shape?

   a. Globe-shaped
   b. Narrow at the base spreading to broad at the top
   c. Tall and narrow
   d. Triangular

3. A plant with large leaves and thick branches and twigs has a _____ texture.

   a. coarse
   b. fine
   c. rough
   d. smooth

4. Bark on a plant that is described as **exfoliate** is bark

   a. of more than one color.
   b. with raised ridges or bumps.
   c. with stripes running up and down the tree.
   d. that peels.

5. Which of the following statements is true concerning trees? They

   a. have only one main trunk.
   b. may have several main trunks.
   c. are 30 feet tall or taller.
   d. are all deciduous.

6. A plant with many branches that hang down toward the ground is _____ in shape.

   a. columnar
   b pyramidal
   c. vase-shaped
   d. weeping

(continued)

7. Name three characteristics of stems besides lenticels, leaf scars, and pith that are useful in plant identification. *(6 points)*

   a _____

   b _____

   c _____

8. List three ways that you personally will be able to use plant identification skills. *(12 points)*

   a _____

   b _____

   c _____

9. Why do you think it is useful to be able to identify plants at all times of the year? *(6 points)*

   _____

   _____

   _____

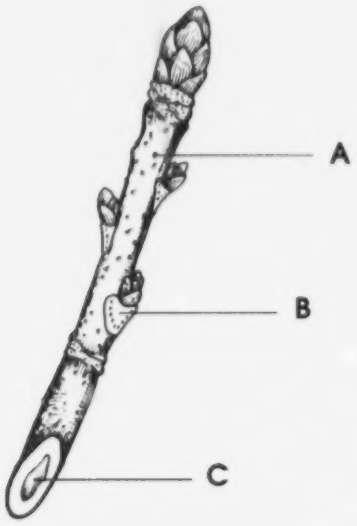
   _____

   _____

(continued)

Stem Identification

Referring to this graphic, answer questions 10-13 below by circling the letter of the correct response. *(6 points each)*



10. Structure A is

    a. a leaf scar.
    b. a lenticel.
    c. pith.
    d. pubescence.

11. Choose the statement that best describes structure A.

    a. Corky spot
    b. Fuzzy, hair-like growth
    c. Mark left on the stem when a leaf drops off
    d. Thorn or spine

12. Structure B is

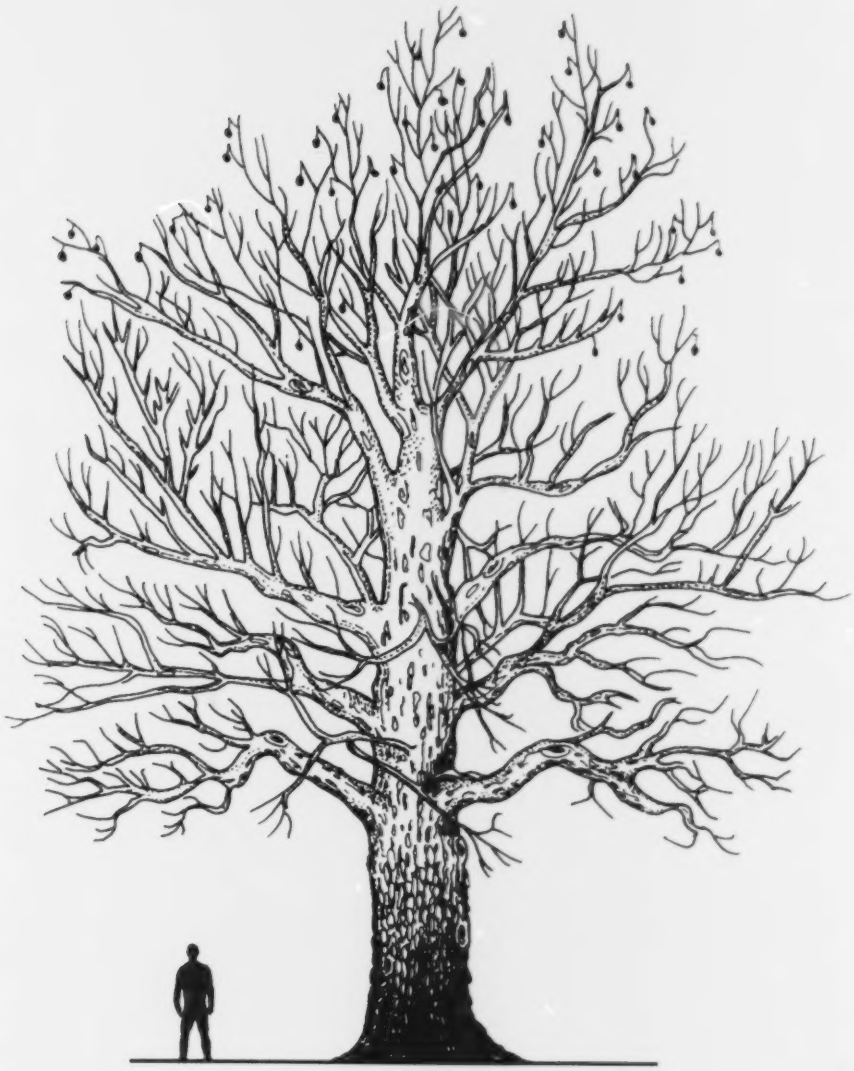
    a. a leaf scar.
    b. a lenticel.
    c. pith.
    d. pubescence.

13. Structure C is

    a. a leaf scar.
    b. a lenticel.
    c. pith.
    d. pubescence.

(continued)

Tree Identification



14. List four characteristics of this tree that could be used to help identify it. *(16 points)*

a _____

b _____

c _____

d _____

NAME _____

YEAR- ROUND IDENTIFICATION WORKSHEET

General Appearance

1. What is the approximate size of the plant?

   height _____

   width _____

2. What is the shape of the plant?

   _____

3. Does the plant have single or multiple main trunks?

   _____

4. Describe the texture of the plant.

   _____

   _____

Bark Characteristics

5. What is the color of the bark? _____

6. Is the bark exfoliating? _____

7. Are there any unique patterns or textures to the bark? _____

   If so, describe. _____

   _____

Stem Characteristics

8. What is the color of the stems?

   older growth _____

   younger growth _____

(continued)

Stem Characteristics *(continued)*

9. Do stems have a distinctive shape? _____

   If yes, describe. _____

   _____

10. Are stems pubescent? _____

11. Do stems have an odor when scratched? _____

    If yes, describe the odor. _____

12. Are thorns or spines present on stems? _____

    If yes, describe them. _____

    _____

13. Are lenticels present on stems or trunks? _____

    If yes, describe their appearance. _____

    _____

14. Can you find leaf scars? Describe their appearance.

    _____

15. Examine the stem pith. Is the pith solid, chambered, or hollow?

    _____

    What color is the pith? _____

This plant is _____

LESSON 6

Leaf Characteristics Useful in Spring and Summer Plant Identification

Objectives

At the end of this lesson, students should be able to

1. name and locate the major parts of a leaf.
2. tell a simple leaf from a compound leaf, and to differentiate among pinnate, bipinnate, and palmate compound leaves.
3. describe leaf arrangement and its importance in plant identification.
4. describe the major types of leaf margins (entire, toothed, lobed, wavy).
5. evaluate plant foliage in terms of simple or compound leaves, arrangement, leaf margins, leaf shapes, leaf bases, leaf tips, leaf color, and leaf surfaces for identification purposes.

Resources/Materials

- slide projector and **slides 83-131**
- photocopies of **Summer Identification Outline**
- photocopies of the evaluation pages - **Leaf Characteristics Review**
- overhead transparencies and/or photocopies of **graphics 6-1, 6-2, 6-3,** and **6-4**
- leaf specimens illustrating parts of a leaf (1)
- leaf specimens illustrating simple and compound foliage, different types of arrangement, and various leaf margins (2)
- cans or jars and identification labels (3)
- leaf specimens illustrating various shapes, leaf bases, leaf tips, colors, and leaf surfaces (4)

Terms to Learn

foliage
leaflet
leaf blade
leaf veins
leaf margin
entire leaf margin
toothed leaf margin
lobed leaf margin
wavy leaf margin
leaf petiole
leaf base
leaf tip
stipule
bud
simple leaf
compound leaf
pinnate
bipinnate
palmate
leaf arrangement
opposite arrangement
alternate arrangement
whorled arrangement
variegated
pubescence

Procedures

1. Introduction - Use the interest approach.

   - First teach Lesson 1. If it has already been taught, review with students the necessity for developing good plant identification skills. Encourage students to add additional reasons to their original list.

   - As an example, ask students how they are able to find their cars when parked at a crowded shopping mall. They will respond, "We know what our cars look like." Ask one or two students to list individual identifying characteristics of their cars. Draw parallels to plant identification, in that all plants have particular characteristics by which they are identified. Plant identification involves learning a plant's characteristics.

   - Introduce the topic of summer identification. Give students the **Summer Identification Outline** (pages 47-48) for their notebooks. Explain that these plant identification features will be useful in identifying plants during the growing season.

2. Show slides 83-87.

   - Introduction to spring and summer identification of plants

   - Leaf characteristics - identifying basic parts of a leaf: leaf blade, veins, leaf margin, petiole, stipule, and bud

Procedures - *continued*

3. Have students work with **graphic 6-1, Parts of a Leaf** (top section).

4. Perform Activity 1 if desired.

5. Show slides 88-98 - Simple or Compound Leaves.

   - definitions of simple and compound leaves and how to tell them apart
   - definitions of pinnate, bipinnate, and palmate compound leaves and how to recognize them

6. Have students work with **graphics** **6-1, Parts of a Leaf** (bottom section)
   6-2, Simple and Compound Leaves

7. Show slides 99-111 - Leaf Arrangement and Leaf Margin.

   Leaf arrangement - opposite, alternate, and whorled leaf arrangement
   Leaf margins - entire, wavy, toothed, and lobed leaf margins

8. Have students work with **graphics** **6-3, Leaf Arrangement**
   6-4, Leaf Margins

9. Perform Activities 2 and 3 if desired.

10. Show slides 112-131 - Leaf Shape, Color, and Surfaces.

    Leaf shape
    - leaf bases
    - leaf tips

    Leaf color
    - for species with leaf color other than green
    - comparing the leaf color of species that stay the same all season with those that have a different color and revert to green
    - variegation

    Leaf surfaces - those that are shiny and glossy and those with pubescence

11. Perform Activities 4 and 5 if desired.

12. Evaluate student learning.

Activities

1. Bring leaf specimens to class. Have the students locate the blade, veins, leaf margins, petiole, and buds.

2. Bring to class cut twigs with leaves attached from several plant species. If possible, bring in examples of simple and compound foliage; opposite, alternate, and whorled arrangements; and several types of leaf margins. Have students answer the following questions for each cut specimen:

   - Are the leaves simple or compound?
   - What is the leaf arrangement?
   - What type of leaf margin does the leaf have?

   Tell students the identity of each specimen. If possible, take students outdoors to examine plants for these leaf characteristics.

   Note: Lists of the more common plant species that possess the different leaf characteristics discussed in this lesson are found on pages 45-46. (These lists are by no means exhaustive.)

3. Place each twig-and-leaf specimen in a can of water. Label each can with the species name and the leaf characteristics.

4. Bring to class examples of leaves that have distinctive shapes, and leaves with bases and tips that are distinctively shaped. Also bring examples of leaves of different colors and leaves with heavy pubescence.

5. Have students assemble leaf collections (with guidelines as to appropriate collection sites). Each specimen should be labeled as to its identity, simple or compound leaves, leaf arrangement, and type of leaf margin.

Evaluation

1. Give students photocopies of **Leaf Characteristics Review** (pages 43-44).

Answer Key

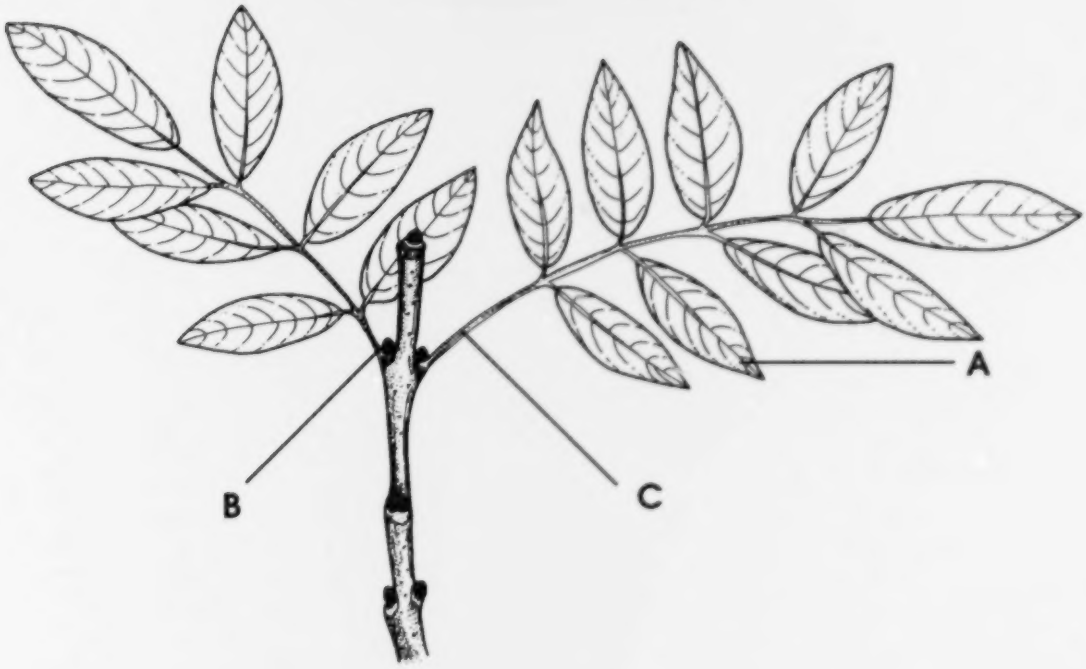
1.	b	5.	a
2.	b	6.	c
3.	a	7.	d
4.	b		

2. If you did Activities 1 and 4, bring different leaves to class. Have students locate and describe the leaf blade, leaf veins, leaf margins, bud, leaf base, leaf tip, and leaf shape. Have them name any other identifying characteristics that are present, such as pubescence or unusual color.

3. If you did Activity 2, repeat the exercise using new specimens.

NAME _____

Leaf Characteristics Review



With reference to the above graphic, answer questions 1-7 by circling the correct answer.

1. This type of leaf is
   a. simple.
   b. pinnately compound.
   c. bipinnately compound.
   d. palmately compound.

2. The leaf arrangement shown here is
   a. alternate.
   b. opposite.
   c. sub-opposite.
   d. whorled.

3. The leaf margins shown above are
   a entire.
   b. lobed.
   c. toothed.
   d. wavy.

(continued)

4. Structure A is the

   a. leaf blade.
   b. leaflet.
   c. petiole.
   d stipule.

5. Structure B is the

   a. bud.
   b. leaf base.
   c. petiole.
   d. veins.

6. Structure C is the

   a. bud.
   b. leaf base.
   c. petiole.
   d. stipule.

7. Which of the following is true concerning these leaves?

   a. Leaves are variegated.
   b. Leaflets are pubescent.
   c. Leaf tips are rounded.
   d. Leaflets are oval-shaped.

8. How is leaf arrangement useful in identifying plants?

List of Selected Trees and Shrubs by Leaf Characteristics

Compound Leaves

Pinnately Compound

tree of heaven *(Ailanthus altissima)*
bush cinquefoil *(Potentilla fruticosa)*
American elder *(Sambucus canadensis)*
black locust *(Robinia pseudoacacia)*
boxelder *(Acer negundo)*
American yellowwood *(Cladrastis kentuckea)*
panicled goldenraintree *(Koelreuteria paniculata)*
Japanese pagodatree *(Sophora japonica)*
sumac *(Rhus)*
rose *(Rosa)*
walnut *(Juglans)*
hickory *(Carya)*
ash *(Fraxinus)*
mountainash *(Sorbus)*

Bipinnately Compound

Kentucky coffeetree *(Gymnocladus dioicus)*
thornless common honeylocust *(Gleditsia triacanthos* var. *inermis)* - with foliage either pinnate or bipinnate
devil's-walking stick *(Aralia spinosa)*

Palmately Compound

buckeye and horsechestnut *(Aesculus)*
fiveleaf aralia *(Acanthopanax sieboldianus)*

Leaf Arrangement

Alternate - Most trees and shrubs

Opposite

maple *(Acer)*
dogwood *(Cornus)* - except *Cornus alternifolia*
honeysuckle *(Lonicera)*
buckeye and horsechestnut *(Aesculus)*
ash *(Fraxinus)*
viburnum *(Viburnum)*
privet *(Ligustrum)*

List of Trees and Shrubs by Leaf Characteristics - *continued*

Whorled

northern catalpa *(Catalpa speciosa)*

Leaf Margins

Entire

white fringetree *(Chionanthus virginicus)*
common sweetshrub *(Calycanthus floridus)*
eastern redbud *(Cercis canadensis)*
lilac *(Syringa)*
most dogwoods *(Cornus)*
black tupelo *(Nyssa sylvatica)*

Wavy

cranberry cotoneaster *(Cotoneaster apiculatus)*
European beech *(Fagus sylvatica)*

Toothed

Members of the following genera:

serviceberry *(Amelanchier)*
birch *(Betula)*
floweringquince *(Chaenomeles)*
linden *(Tilia)*
viburnum *(Viburnum)*
spirea *(Spiraea)*
elm *(Ulmus)*

Lobed

Washington hawthorn *(Crataegus phaenopyrum)*
American sweetgum *(Liquidambar styraciflua)*
sycamore, London planetree *(Platanus)*
tuliptree *(Liriodendron tulipifera)*
maples *(Acer)* (certain species)
oaks *(Quercus)* (certain species)

Summer Identification Outline

I **Leaf Characteristics**

A. Parts of a leaf

B. Simple or compound leaves
- + pinnately compound
- + bipinnately compound
- + palmately compound

C. Leaf arrangement
- + opposite
- + alternate
- + whorled

D. Leaf margins
- + entire
- + toothed
- + lobed
- + wavy

E. Leaf shape
- + leaf base
- + leaf tip

F. Leaf color

G. Leaf surfaces

II **Flower Characteristics**

A. Purpose of flowers

B. Parts of flowers

C. Monoecious and dioecious plants

D. Solitary or clustered flowers

E. Flower color

F. Time of flowering

Summer Identification Outline
continued

III **Fruit Characteristics**

A. Type of fruit
- fleshy fruit
- dry fruit
  - pods
  - capsules
  - samaras
  - nuts and acorns

B. Time of ripening

C. Fruit color

Summer Identification Outline

I **Leaf Characteristics**

A. Parts of a leaf

B. Simple or compound leaves
- pinnately compound
- bipinnately compound
- palmately compound

C. Leaf arrangement
- opposite
- alternate
- whorled

D. Leaf margins
- entire
- toothed
- lobed
- wavy

E. Leaf shape
- leaf base
- leaf tip

F. Leaf color

G. Leaf surfaces

II **Flower Characteristics**

A. Purpose of flowers
B. Parts of flowers
C. Monoecious and dioecious plants
D. Solitary or clustered flowers
E. Flower color
F. Time of flowering

Summer Identification Outline
continued

III **Fruit Characteristics**

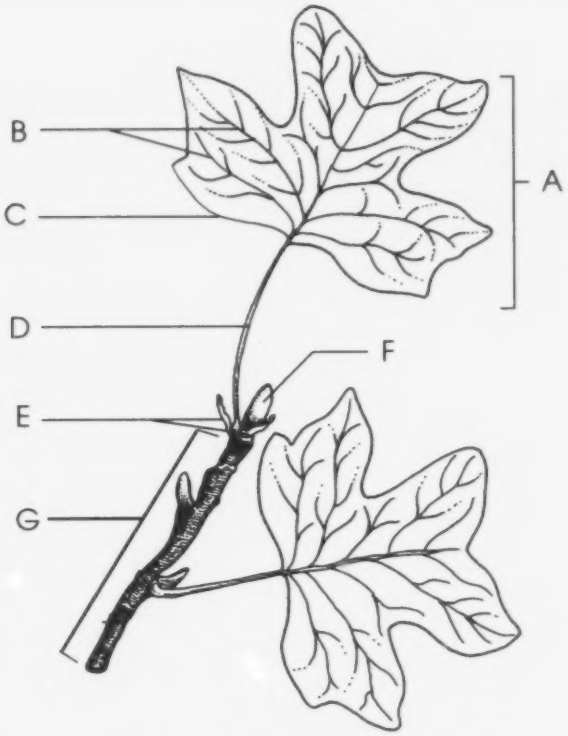
A. Type of fruit
- ✢ fleshy fruit
- ✢ dry fruit
  - pods
  - capsules
  - samaras
  - nuts and acorns

B. Time of ripening

C. Fruit color

Graphic 6-1

Parts of a Leaf



A _____

B _____

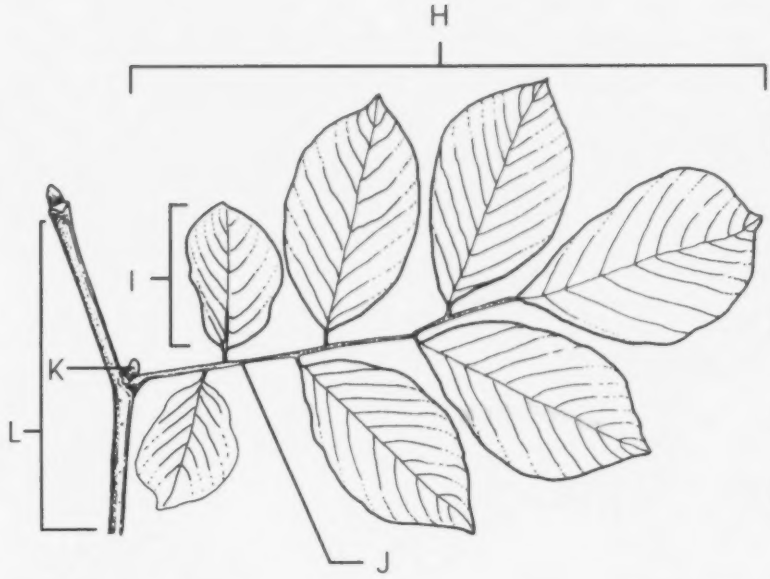
C _____

D _____

E _____

F _____

G _____



H _____

I _____

J _____

K _____

L _____

Graphic 6-2

Simple and Compound Leaves

Simple Leaf

Compound Leaves

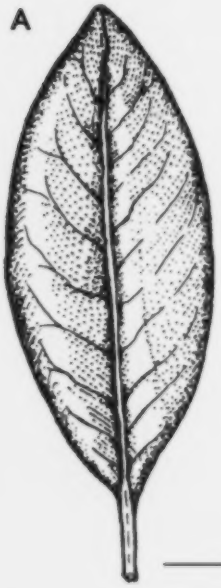
Graphic 6-3

Leaf Arrangement

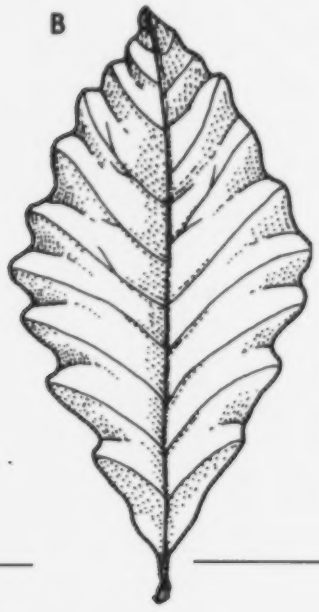
Graphic 6-4

Leaf Margins

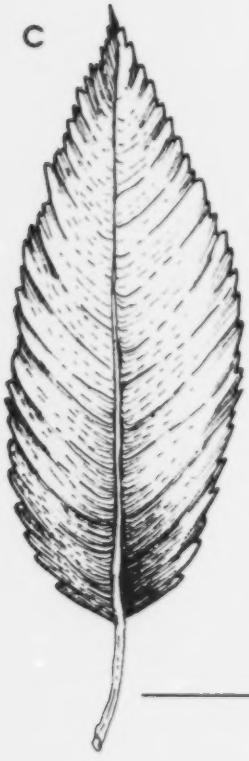
A



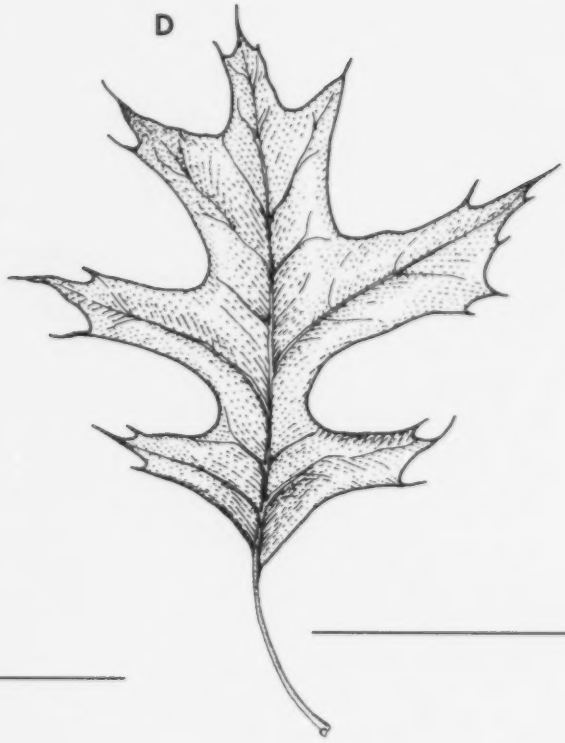
B



C



D



LESSON 7
Flower Characteristics Useful in Spring and Summer Plant Identification

Objectives

At the end of this lesson, students should be able to

1. name and locate the major parts of a flower.

2. evaluate flowers in terms of solitary or clustered, color, and time of bloom for use in identification.

Resources/Materials

- slide projector and **slides 132-164**
- overhead projector
- overhead transparencies and/or photocopies of **graphics 7-1, 7-2,** and **7-3**
- photocopies of the evaluation page **Fill-in-the-Blanks & Word Search Puzzle**
- live cut flowers with sepals, petals, pistils, and stamens clearly visible (1)
- ripe fruit of ginkgo *(Ginkgo biloba)*, if possible, and pictures of dioecious plant species with ornamental fruit, such as hollies (3)
- cut twigs with flowers (4)
- magazines and nursery catalogs, reference materials (5)

Terms to Learn

- flower parts: petal, sepal, stamen, pistil
- male flower
- female flower
- catkin
- monoecious
- dioecious
- solitary flower
- flower cluster

Note:

The classic botanical name for male flowers is staminate and for female flowers is pistillate. Use this terminology if you prefer.

The concepts of complete, incomplete, perfect, and imperfect flowers are not developed in this slide series because they are not essential to identification. Also, though the stigma, style, ovary, and anther and filament are labeled in slide 136, they are not discussed in this lesson. You are free to go into greater detail with these terms, if you choose.

Procedures

1. Review material from previous lesson and introduce topic.

2. Show slides 132-137 - Characteristics of Flowers

   Introduction and purpose of flowers
   - showy, ornamental flowers vs. hard-to-recognize flowers
   - what is the basic function of flowers

   Parts of a flower - petals, sepals, stamens, pistils

3. Have students work with **graphics:** **7-1, Purpose of Flowers and Fruit**
   7-2, Parts of a Flower

4. Perform Activity 1 if desired.

5. Show slides 138-145.

   - Separate male and female flowers
   - Monoecious and dioecious plant species defined and illustrated

6. Have students work with **graphic 7-3, Male and Female Flowers**.

7. Perform Activities 2 and 3 if desired.

8. Show slides 146-164.

   - Solitary or clustered flowers
   - Flower color
   - Time of flowering

9. Perform Activities 4, 5, 6, and 7 if desired.

10. Evaluate student learning.

Activities

1. Bring live cut flowers to class. Have students practice finding sepals, petals, pistils, and stamens.

2. If any monoecious or dioecious species are in bloom, take students outdoors and show them the separate flowers. Or bring cut specimens to class.
   Point out to students how an awareness of monoecious and dioecious species helps in plant identification (for example, different appearance of flowers, and fruiting vs. non-fruiting individuals within a species).

3. Impress on students that with certain **dioecious** plant species, the sex of the plant determines its use in the landscape. When fruit or seeds are **not** wanted, male plants are usually chosen. Female ginkgo trees, for example, produce foul-smelling fruit that is messy when it falls to the ground. For this reason, male ginkgo trees are preferred for use in the landscape. Have students smell a ripe ginkgo fruit, if possible.

   If the fruit and/or seeds are ornamentally attractive, female plants are usually preferred. An example is holly (*Ilex* species) with its attractive fruit. Show students pictures of plants in fruit.

   Point out that when dioecious plant species are grown for ornamental fruit, at least one male plant must be present to assure pollination and fruit set.

4. Take students outdoors to examine plants in bloom. Or bring cut flower specimens to class. For each specimen, have students answer the following questions:
   - What color is the flower?
   - Are the flowers solitary or clustered?

5. Have students cut pictures from magazines and nursery catalogs of plants with ornamental flowers. Prepare labels for each picture containing the plant's name, season of bloom, range in flower color for the species, and whether the flowers are solitary or clustered. Group pictures and labels on the bulletin board by month of bloom. Or have students keep their collections in their notebooks.

   As the result of this exercise, students should be aware that most deciduous trees and shrubs are **spring-flowering**. However, introduce the students to **summer-flowering** species, too. Point out how valuable these species are for adding color and interest to the landscape during the summer months.

6. In spring, have students make a list of deciduous trees and shrubs that they have actually seen in bloom. The list should include the species name, location of the plant, flower color, and dates flowering begins and ends. This list will help students learn the sequence of plants' blooming throughout the spring months.

(continued)

Activities - *continued*

7. In courses covering landscape design, point out that sequence of bloom as well as flower color and form are important considerations in designing a landscape.

Evaluation

1. **Fill-in-the-Blanks and Word Search**

   As you give each student a copy, make sure they understand the directions for the Fill-in-the-Blanks & Word Search puzzle (page 57).
   (See Answer Key below.)

2. If you did Activity 1, bring in new specimens and have students identify the flower parts.

3. If you did Activity 5, ask students to list species that bloom in each of the following time periods:

   Spring (March through May)
   Summer (June through August)
   Fall (September and later)

Answer Key

Words that fill in the blanks and are then circled in the word search puzzle:
(Example: FLOWERS)

C K L I P B S T R Y A P
S L D M B C S D E E S E
E G U I I K M O Q U S T
S F L S O B J N O A B A
T L U D T E G I L N R L
A O L F C E C W N Z V S
M W D A B E R I T C U L
E E G Y O A K P O H T I
N R T N D T A L H U E T
S S O D A J O P F D S S
R M E C T R B W I N T I
E Y R A T I L O S G H P

1. seeds
2. cluster
3. petals
4. dioecious
5. stamens
6. catkin
7. solitary
8. monoecious
9. color
10. pistils

NAME _____

Flower Characteristics
Fill-in-the-Blanks & Word Search Puzzle

C K L I P B S T R Y A P
S L D M B C S D E E S E
E G U I I K M O Q U S T
S F L S O B J N O A B A
T L U D T E G I L N R L
A O L F C E C W N Z V S
M W D A B E R I T C U L
E E G Y O A K P O H T I
N R T N D T A L H U E T
S S O D A J O P F D S S
R M E C T R B W I N T I
E Y R A T I L O S G H P

Directions: First, fill in the blanks in each numbered statement below with the correct number of letters for each missing word. Then find that word in the word search puzzle above and circle the word. The letters can run up or down, forwards or backwards, or diagonally.

Example: F L O W E R S are helpful in plant identification.

1. The basic purpose of flowers is to produce _ _ _ _ _ so that plants can reproduce.
2. Many small flowers grouped together is called a flower _ _ _ _ _ _ _.
3. The structures of a flower that are often colorful and attractive are the _ _ _ _ _ _.
4. One possible reason why a certain tree may fail to produce fruit is that the species is _ _ _ _ _ _ _ _ _ and the tree is male.
5. Male flowers have only these reproductive structures: _ _ _ _ _ _ _.
6. The type of flower found on birches and willows is a _ _ _ _ _ _.
7. A single flower borne at the end of a flower stalk is known as a _ _ _ _ _ _ _ _ flower.
8. Plants that produce separate male and female flowers on the same plant are known as _ _ _ _ _ _ _ _ _ _.
9. The flower characteristic that is easiest to use in plant identification is its _ _ _ _ _.
10. The flower structures in which the fruit and seeds will form are the _ _ _ _ _ _ _.

Monoecious and Dioecious Species

Plants may exhibit variability among individuals, particularly with regard to flowering characteristics. Certain individual plants in a species may have a dioecious character, even though most members of the species are monoecious. Likewise, individual plants of some dioecious species show monoecious characteristics.

Monoecious Species

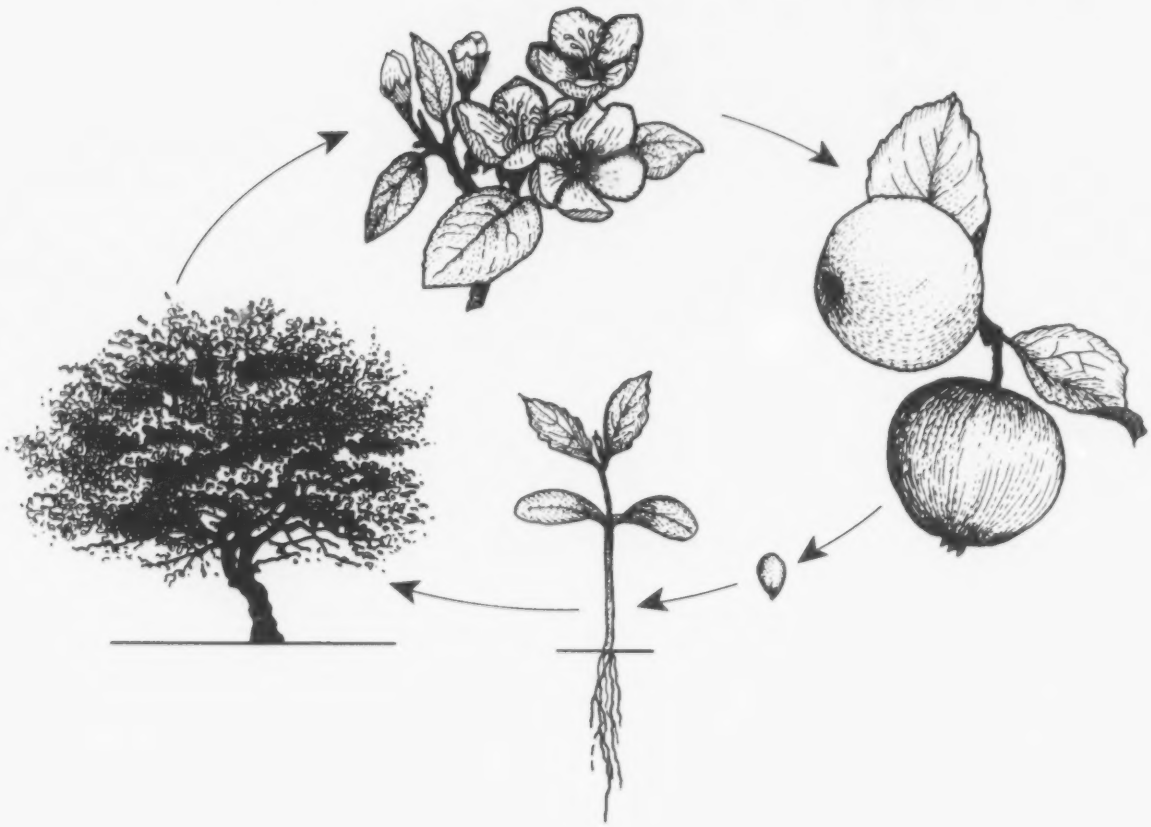
alder *(Alnus)*
birch *(Betula)*
hornbeam *(Carpinus)*
hickory *(Carya)*
beech *(Fagus)*
walnut *(Juglans)*
American hophornbeam *(Ostrya virginiana)*
oak *(Quercus)*

Dioecious Species

northern bayberry *(Myrica pensylvanica)*
ginkgo *(Ginkgo biloba)*
holly *(Ilex)*
tree of heaven *(Ailanthus altissima)*
katsuratree *(Cercidiphyllum japonicum)*
white fringetree *(Chionanthus virginicus)*
osage-orange *(Maclura pomifera)*
mulberry *(Morus)*
amur corktree *(Phellodendron amurense)*
poplar *(Populus)*
sumac *(Rhus)*
Alpine currant *(Ribes alpinum)*
willow *(Salix)*
persimmon *(Diospyros virginiana)*
spicebush *(Lindera benzoin)*
bittersweet *(Celastrus)*

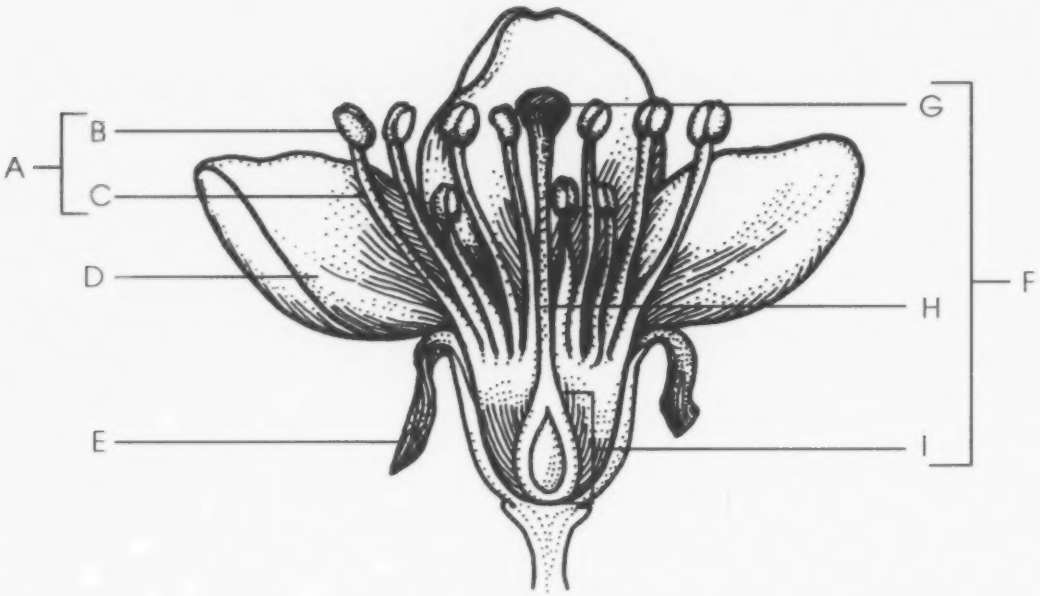
Graphic 7-1

Purpose of Flowers and Fruit



Graphic 7-2

Parts of a Flower



A _____ F _____

B _____ G _____

C _____ H _____

D _____ I _____

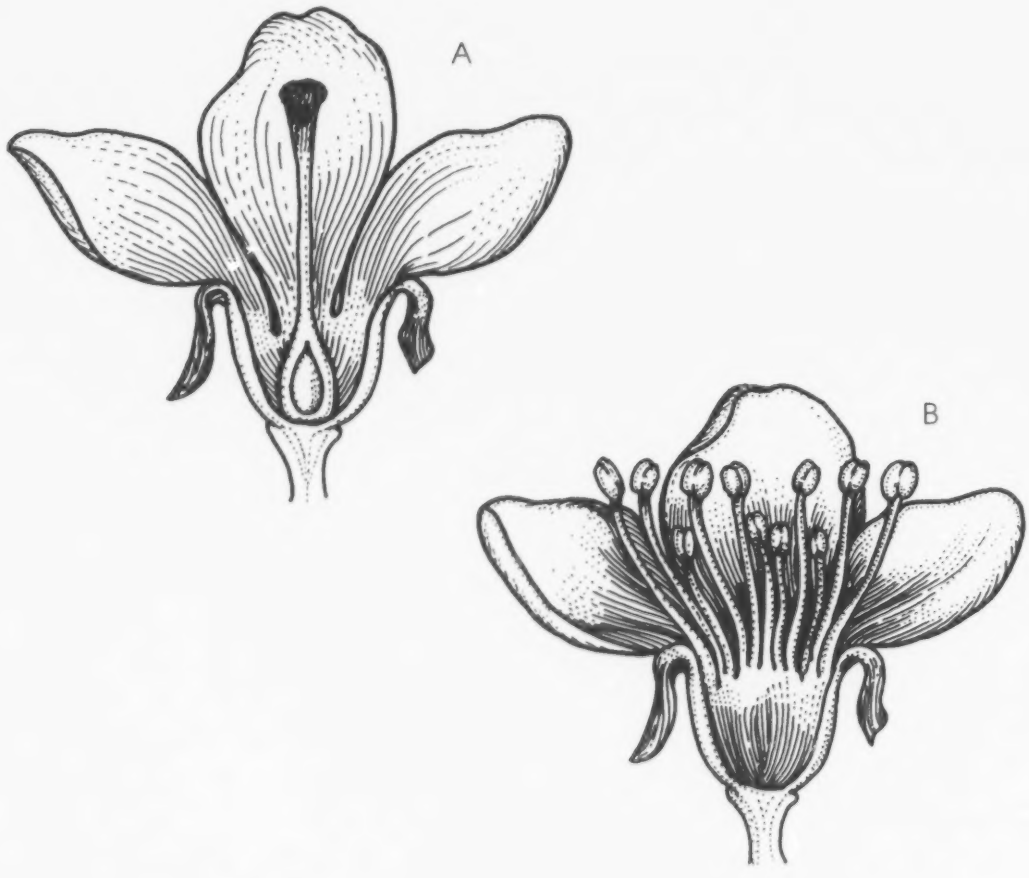
E _____

1. Which of these structures produces pollen? _____

2. Which of these structures produces fruit and seeds? _____

Graphic 7-3

Female and Male Flowers



Which of these two flowers is capable of producing fruit and seed?

LESSON 8

Fruit Characteristics Useful in Summer and Fall Plant Identification

Objectives

At the end of this lesson, students should be able to

1. describe fleshy and dry fruits and list major types of dry fruit.
2. evaluate fruit in terms of type, time of ripening, and color for identification purposes.

Resources/Materials

- slide projector and **slides 165-190**
- overhead projector
- overhead transparency and/or photocopies of **graphic 8-1**
- photocopies of the evaluation page **Fruit Characteristics Review**
- specimens of fleshy fruit and the following types of dry fruits: pods, capsules, samaras, and nuts and acorns (1)
- magazines and nursery catalogs containing pictures of plants with ornamental fruit (3)
- reference materials (3,4)
- pictures of plants that bear fruit eaten by wildlife (4)

Terms to Learn

- fruit
- fleshy fruit
- dry fruit
- pod
- capsule
- samara
- nut
- acorn
- acorn cup

BEST COPY AVAILABLE

Procedures

1. Review material from previous lesson and introduce topic.

2. Show slides 165-190 - Fruit Characteristics.

   Introduction - define "fruit"

   Fruit types
   - Fleshy fruits
   - Dry fruits
     pods
     capsules
     samaras
     nuts and acorns

   Time of ripening

   Fruit color

3. Have students work with **graphic 8-1, Types of Fruit**.

4. Perform the Activities suggested.

5. Evaluate student learning.

Activities

1. Bring to class specimens of dry fruit and fleshy fruit for students to examine. Attach each specimen to the bulletin board with labels as to species and type of fruit.

   Note: Lists of the more common plant species that possess the different types of fruit discussed in this lesson are included on page 67. These lists are by no means exhaustive. Feel free to add your own examples.

2. Point out to students that fruit can be either desirable or undesirable. Some fruits are ornamentally attractive, while others are a messy nuisance when they fall to the ground.

3. Have students cut pictures from magazines and nursery catalogs of plants with ornamental fruit. Using reference materials, have the students prepare labels for each picture containing the plant's name, the type of fruit, the time of fruit

Activities- *continued*

ripening, and the fruit color. Post pictures and labels on a bulletin board or have students keep their collections in their notebooks.

4. Point out that fruits of some plant species are eaten by birds and wildlife. Using reference materials, have the students make a list of plant species that bear fruit that becomes food for wildlife. Prepare a bulletin board display of pictures of these plant species. Attach a label for each species that shows its identity and the animals that feed on its fruit.

Evaluation

1. Give students the **Fruit Characteristics Review** (page 66). (See Answer Key below.)

2. If you did Activity 1, bring in new specimens of dry and fleshy fruits. Ask the students to identify the fruits by type.

Answer Key

1. *(definition of fleshy fruit)*
2. A samara - maple, ash, etc.
   B pod - redbud, honeylocust, etc.
   C acorn - oak
3. time of ripening and fruit color

NAME _____

Fruit Characteristics Review

1. Define fleshy fruit. How does a fleshy fruit differ from a dry fruit?

_____

_____

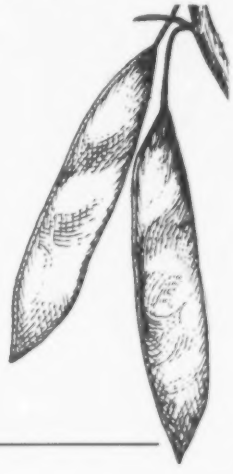
_____

_____

2. Shown below are three types of dry fruit. For each, write the type of dry fruit in the top blank and the name of one plant that possesses this kind of fruit in the bottom blank.

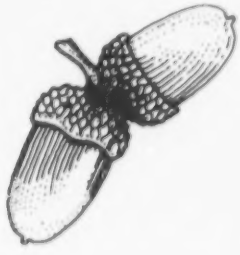
_____

_____



_____

_____



_____

_____

3. Besides fleshy and dry, what other fruit characteristics can be helpful in identifying plants? Name these two characteristics and explain how they are useful in plant identification.

a _____

_____

b _____

_____

List of Selected Trees and Shrubs by Fruit Types

Fleshy Fruit

Members of the following genera:

serviceberry *(Amelanchier)*
cotoneaster *(Cotoneaster)*
privet *(Ligustrum)*
flowering crabapple, apple *(Malus)*
cherry, peach, plum *(Prunus)*
pear, callery pear *(Pyrus)*
dogwood *(Cornus)*
hawthorn *(Crataegus)*
honeysuckle *(Lonicera)*
holly *(Ilex)*
viburnum *(Viburnum)*
hackberry *(Celtis)*
scarlet firethorn *(Pyracantha coccinea)*
chokeberry *(Aronia)*

Dry Fruit

Pods

eastern redbud *(Cercis canadensis)*
thornless common honeylocust *(Gleditsia triacanthos* var. *inermis)*
Kentucky coffeetree *(Gymnocladus dioicus)*
black locust *(Robinia pseudoacacia)*
Japanese pagodatree *(Sophora japonica)*
yellowwood *(Cladrastis kentuckea)*

Capsules

rose-of-sharon *(Hibiscus syriacus)*
panicled goldenraintree *(Koelreuteria paniculata)*
buckeye and horsechestnut *(Aesculus)*
witchhazel *(Hamamelis)*
catalpa *(Catalpa)*
lilac *(Syringa)*
sweet mockorange *(Philadelphus coronarius)*
forsythia *(Forsythia)*
rhododendron *(Rhododendron)*

Samaras

maple *(Acer)*
ash *(Fraxinus)*
elm *(Ulmus)*
tree of heaven *(Ailanthus altissima)*

Nuts and Acorns

hickory *(Carya)*
filbert *(Corylus)*
beech *(Fagus)*
walnut *(Juglans)*
oak *(Quercus)*
chestnut *(Castanea)*

Graphic 8-1

Types of Fruit

Name each type of fruit pictured below and give examples of one or two plants that bear that kind of fruit.

_____
type of fruit

plant examples _____

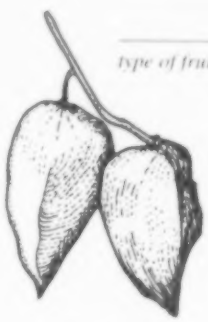
_____

_____
type of fruit

plant examples _____

_____

_____
type of fruit



plant examples _____

_____

_____
type of fruit

plant examples _____

_____

_____
type of fruit

plant examples _____

_____

_____
type of fruit

plant example _____

77

LESSON 9
Using Year-Round and Spring & Summer Identification Characteristics to Identify Plants

Objectives

At the end of this lesson, students should be able to

1. evaluate and identify plants using year-round and summer identification characteristics.
2. consult reference texts as an aid to plant identification.

Resources/Materials

- slide projector and **slides 191-200**
- tree and shrub identification books and guides
- photocopies of both **Year-Round Identification Worksheet** and **Summer Identification Worksheet**
- photocopies of **the evaluation pages - Spring & Summer Identification Exam**
- prizes for scavenger hunt winners (1)
- plant keys (2)

Procedures

This is the final lesson for the Summer Identification Unit. Students can now use the information studied in the preceding three lessons and in the Year-Round Identification Unit to practice identifying plants. Slides 191-200 demonstrate a holistic approach to identification in which a plant is evaluated for a number of identification characteristics. After you have helped students through the practice identification in the slides, have them practice the technique using real plants.

1. Review with students their lists of reasons for the importance of learning plant identification skills, from Lesson 1. Ask them if there are any additional reasons to add to the list. Continue to remind them of the value of plant identification.

(continued)

Procedures - *continued*

2. Review with students the plant identification features discussed in the Year-Round Identification Unit.

3. Review materials from the previous lessons. Tell the students they are now ready to practice using both year-round and summer identification characteristics to identify unknown plants.

4. Show slides 191-200.

5. Bring to class several tree and shrub identification guides and books. Encourage students to look through them. Use these reference materials for the following exercise.

6. Have students work with the Year-Round Identification Worksheet (pages 37-38) (if this unit has been taught) and the Summer Identification Worksheet (pages 77-78). Divide students into small groups. Assign each group a tree or shrub. Students can complete both worksheets to practice examining a plant for features that are useful in identification. When they have completed the worksheets, have the students try to identify their plant using reference texts.

   Another approach is to give students a list of plants which includes the plant to be identified. Have the students use the worksheets and reference texts to determine which plant on the list they are identifying.

7. Evaluate student learning.

Activities

1. Conduct a "scavenger hunt." First, survey a site on school property or in a nearby park for plant species that possess leaf, flower, and fruit characteristics discussed in this unit. Divide the students into groups and have them find plants that demonstrate these characteristics. If possible, depending on the plant species present, have the students find plants with the following:

   - simple and compound foliage
   - opposite, alternate, and whorled leaf arrangements
   - various leaf margins and shapes
   - flowers of a certain color
   - fleshy and dry fruits

   Give prizes to all members of the group that is the first to find all the required specimens.

Activities- *continued*

2. Students should now be familiar with much of the terminology used in plant keys. If you want students to be able to key out plants, you can now teach them how to use a key. Give them opportunity to practice keying out plants.

Evaluation

1. Give students the **Spring and Summer Identification Exam** (pages 72-76), or use the questions for review of this unit. (See Answer Key below.)

2. Take students to a live tree or shrub. Have students make a list of characteristics of that plant that can be used to identify it. Their responses should include descriptions of such year-round identification traits as size, shape, trunk habit, texture, bark features, and stem characteristics, and such summer identification traits as foliage, flower, and fruit characteristics.

Answer Key to Spring and Summer Identification Exam

1. d
2. b
3. c
4. c
5. b
6. a
7. c
8. d
9. a
10. a
11. b
12. c
13. b
14. b
15. d
16. c
17. b
18. d
19. a

NAME _____

Spring and Summer Identification Exam

Circle the letter of the one response for each question that best answers the question or completes the statement. (5 points each)

1. Which of the following statements about flower color is NOT true?

   a. Some plants have flowers of only one color.
   b. Some plants have individual flowers with two or more colors.
   c. Some plants' flowers come in a range of colors.
   d. The flower color of an individual plant depends on the age of the plant.

2. The term ***monoecious*** refers to plants that

   a. have female flowers on one plant and male flowers on a separate plant.
   b. have separate male and female flowers on the same plant.
   c. have flowers with both stamens and pistils.
   d. produce catkins.

3. Which of the following flower characteristics is NOT useful in plant identification?

   a. color
   b. month of bloom
   c. simple or compound flower
   d. solitary or clustered flower

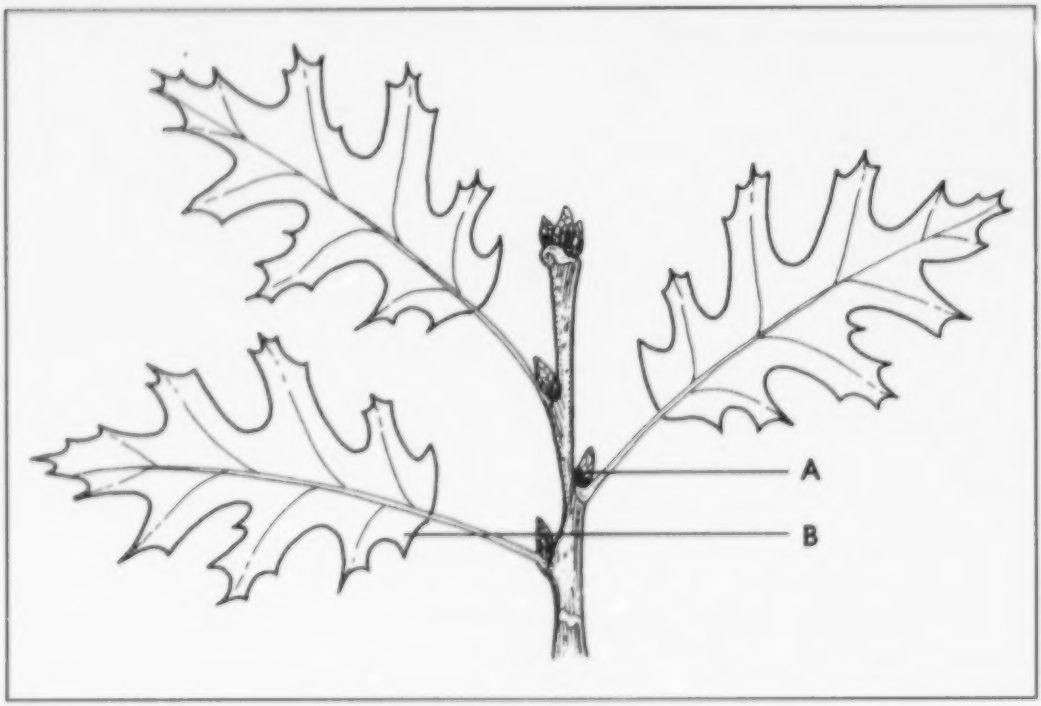
4. Fleshy fruits differ from dry fruits in that fleshy fruits

   a. contain seeds, and dry fruits do not.
   b. ripen mainly in the summer, while dry fruits ripen mainly in the fall.
   c. have soft or hard tissue surrounding the seed, and dry fruits do not.
   d. form from female flowers and dry fruits from male flowers.

5. ***Variegated*** leaves are leaves that

   a. change colors over the growing season.
   b. have two or more colors.
   c. are shiny green.
   d. have hair-like structures covering their surface.

(continued)



Refer to the sketch above to answer **questions 6-10** on this page.

6. This type of leaf is known as

a. simple.
b. pinnately compound.
c. bipinnately compound.
d. palmately compound.

7. The leaf arrangement shown here is

a. opposite.
b. sub-opposite.
c. alternate.
d. whorled.

8. The leaf margin of these leaves is

a. entire.
b. wavy.
c. toothed.
d. lobed.

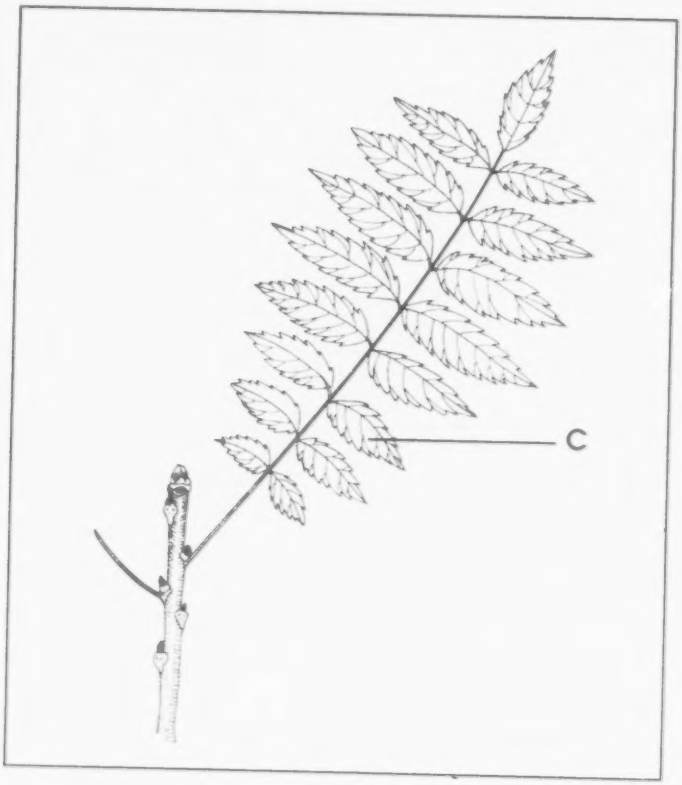
9. Structure A is the

a. bud.
b. leaf base.
c. leaf blade.
d. petiole.

10. Structure B is the

a. leaf base.
b. leaf tip.
c. leaflet.
d. petiole.

(continued)



Refer to the sketch above to answer **questions 11-13**.

11. This type of leaf is known as

    a. simple.
    b. pinnately compound.
    c. bipinnately compound.
    d. palmately compound.

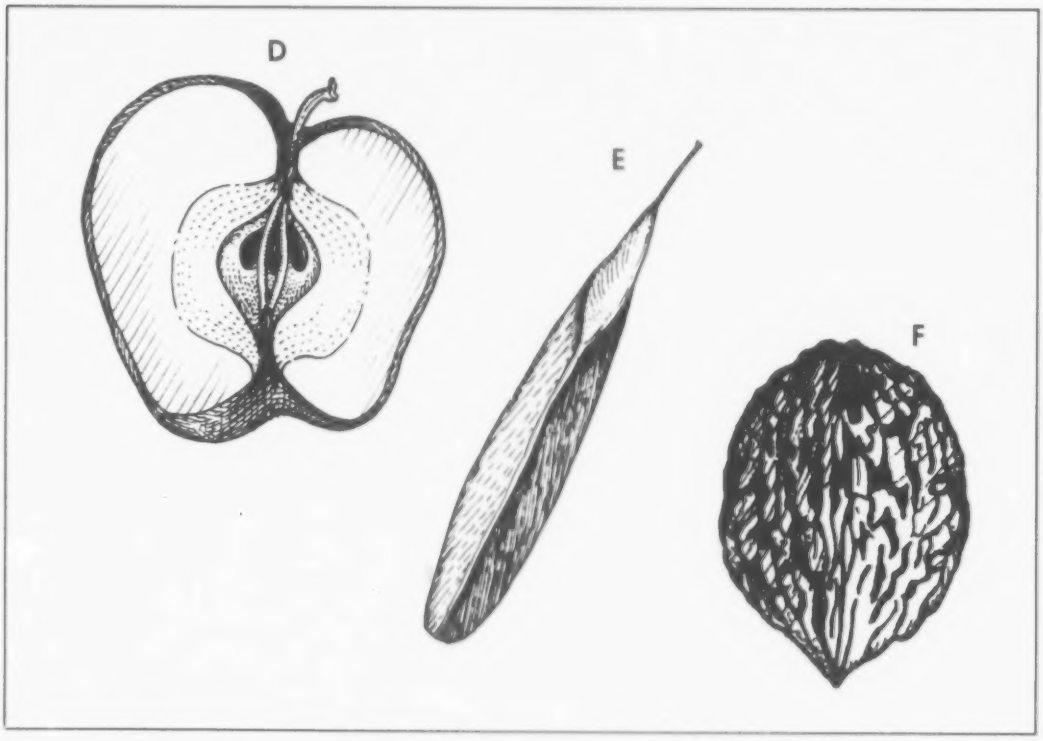
12. The type of leaf margin shown here is

    a. entire.
    b. wavy.
    c. toothed.
    d. lobed.

13. Structure C is the

    a. leaf blade.
    b. leaflet.
    c. petiole.
    d. stipule.

(continued)



Refer to the sketch above to answer **questions 14-16**.

14. Fruit D is a

    a. capsule.
    b. fleshy fruit.
    c. nut.
    d. samara.

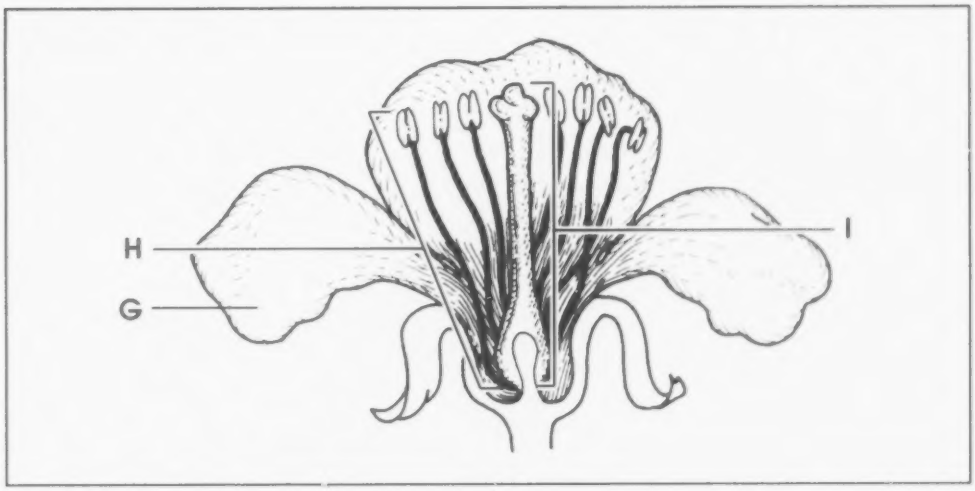
15. Fruit E, the fruit of an ash, is a

    a. capsule.
    b. fleshy fruit.
    c. nut.
    d. samara.

16. Fruit F is a

    a. capsule.
    b. fleshy fruit.
    c. nut.
    d. samara.

(continued)



Refer to the sketch above to answer **questions 17-19.**

17. Structure G is the

    a. sepal.
    b. petal.
    c. pistil.
    d. stamen.

18. Structure H is the

    a. sepal.
    b. petal.
    c. pistil.
    d. stamen.

19. Structure I

    a. is found in a female flower.
    b. is found in a male flower.
    c. produces pollen.
    d. is known as a sepal.

20. List three ways you will be able to use plant identification skills in the future. (5 points)

    a _____

    b _____

    c _____

NAME _____

SUMMER IDENTIFICATION WORKSHEET

Leaf Characteristics

1. Are leaves simple or compound? _____

   If compound, what type of compound leaf? _____

2. Are leaves opposite, alternate, or whorled? _____

3. Are leaf margins entire, wavy, toothed, or lobed? _____

4. Describe the shape of the leaf. _____

   _____

5. Describe the appearance of the leaf base. _____

   _____

6. Describe the appearance of the leaf tip. _____

   _____

7. Describe the coloring of the leaf. _____

8. Do the leaf surfaces have any distinctive characteristics? _____

   If "yes," describe. _____

Flower Characteristics

9. Is the plant flowering? _____

   If "yes," continue with #10. If "no," move on to #13.

10. Are the flowers solitary or clustered? _____

11. What is the flower color? _____

12. This month is _____

(continued)

SUMMER IDENTIFICATION WORKSHEET - *continued*

Fruit Characteristics

13. Is there any fruit present? _____

    If "yes," continue with #14. If "no," move on to #16.

14. Is the fruit fleshy or dry? _____

15. What color is the fruit? _____

16. This month is _____

This plant is _____

S7

LESSON 10
Using Persistent Leaves, Flower Structures, and Persistent Fruit for Plant Identification in Winter

Objectives

At the end of this lesson, students should be able to

1. examine plants for persistent leaves.
2. examine plants for flower structures.
3. examine plants for persistent fruit.
4. describe fleshy and dry fruits and list major types of dry fruit.

Resources/Materials

- slide projector and **slides 201-221**
- leafless twigs (with easily recognizable characteristics)
- photocopies of **Winter Identification Outline**
- photocopies of **the evaluation** page **Crossword Puzzle**
- **graphic 8-1** for review
- catkins from various plant species (2)
- reference materials (3)
- pictures of plants with ornamental, persistent fruit (3)

Terms to Learn

- persistent
- catkin
- fruit
- fleshy fruit
- dry fruit
- pod
- capsule
- samara
- nut
- acorn
- acorn cup

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Procedures

1. Introduction (Interest Approach)

   - ✢ Teach Lesson 1 if you have not already done so. Review with students why they need good plant identification skills. Have students add more reasons to the list they made in Lesson 1.

   - ✢ Lead students in a discussion of why they must be able to identify plants that are not in leaf. Ask students how they think they could identify plants in winter.

   - ✢ Bring to class leafless twigs from several different plants. Ask students if they think plants can be identified simply by observing their twigs. Then, as the students examine the twigs, point out the individual differences.

   - ✢ Give students the Winter Identification Outline (page 83) for their notebooks. These are the plant identification features the students will find useful in identifying plants during the winter months.

2. Show slides 201-221 - Winter Identification.

   - ❍ Introduction
   - ❍ Persistent leaves
   - ❍ Flower structures
   - ❍ Persistent fruit
     - * Fleshy
     - * Dry
       pods
       capsules
       samaras
       nuts and acorns

3. Have students review graphic 8-1 (page 68) for fruit types.

4. Perform the activities suggested.

5. Evaluate student learning.

Activities

1. Take students outdoors and allow them to inspect plants, looking for persistent leaves, flower structures, and persistent fruit.

2. Bring in catkins from various plant species for the students to examine. Display the catkins on a bulletin board with a label for each one indicating the plant species from which it came.

3. Point out how ornamental fruit that persists through the fall and winter months adds color and beauty to the landscape. Using reference materials, have the students compile a list of plants that have persistent, ornamental fruit, along with the length of time these fruits are effective. Find pictures of plants with ornamental, persistent fruit and post them on a bulletin board, labeling each by name.

Evaluation

Distribute copies of the crossword puzzle (page 82).

Answer Key

ACROSS		DOWN	
4	crabapple	1	fleshy fruit
6	persistent	2	oak
7	nut	3	leaves
8	samara	4	catkin
		5	pod
		9	acorn

* * * * * * * * * * * * * * * *

List of Selected Plants with Ornamental Fruit that Persists through the Fall and/or Winter

northern bayberry *(Myrica pensylvanica)*
Kentucky coffeetree *(Gymnocladus dioicus)*
winterberry *(Ilex verticillata)*
possumhaw *(Ilex decidua)*
American sweetgum *(Liquidambar styraciflua)*

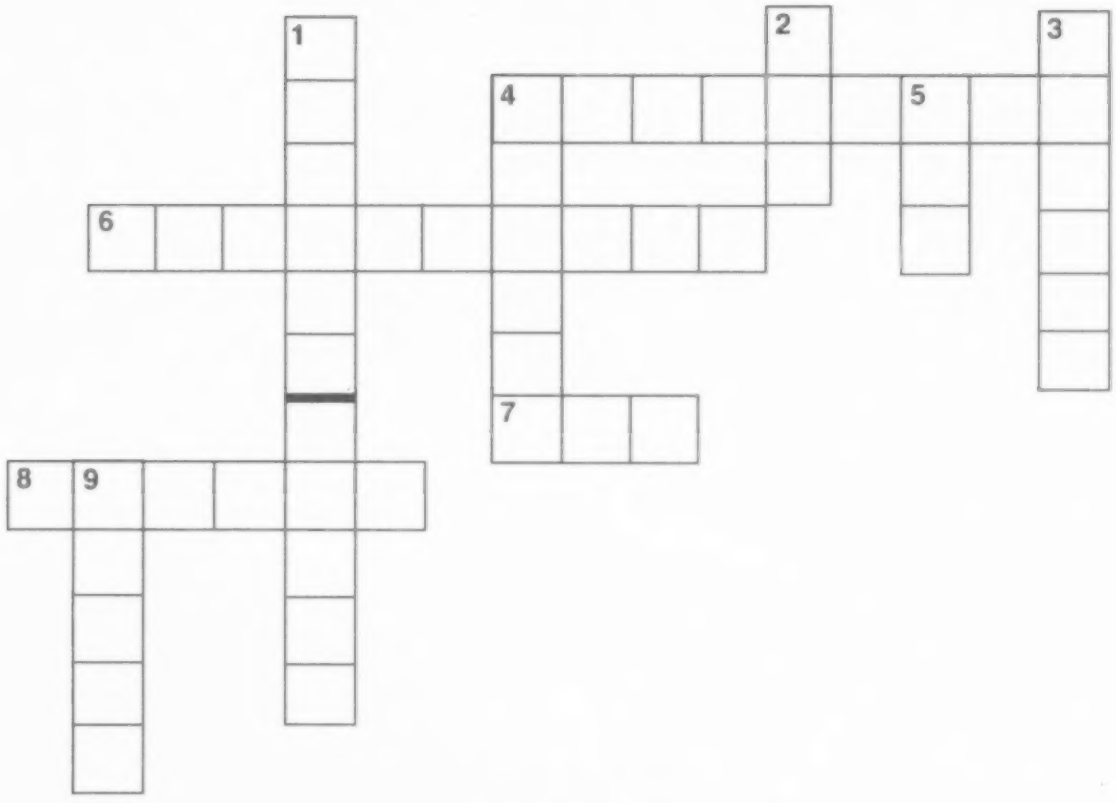
Also, members of the following genera:

crabapple *(Malus)*
hawthorn *(Crataegus)*
viburnum *(Viburnum)*
bittersweet *(Celastrus)*
chokeberry *(Aronia)*
some types of roses *(Rosa)*

NAME _____

Persistent Leaves, Flower Structures, Persistent Fruit

Crossword Puzzle



ACROSS

4 Common tree with fleshy fruit
6 Remaining on a tree or shrub for a long time (applied to leaves and fruit)
7 Dry fruit either partly or entirely covered by a husk
8 Fruit of elms

DOWN

1 Has soft or firm tissue surrounding the seed (two words)
2 Kind of tree with many dead leaves persisting through the winter
3 What deciduous trees and shrubs lack during the winter
4 Type of flower structure persistent in winter
5 A long, narrow, dry type of fruit
9 Fruit of oaks

Winter Identification Outline

I Persistent Leaves

II Flower Structures

III Persistent Fruit

- A. Fleshy fruit
- B. Dry fruit
  1. pods
  2. capsules
  3. samaras
  4. nuts and acorns

IV Buds

- A. Terminal buds
  1. single or clustered
  2. terminal bud scale scar
- B. Lateral buds
  1. single or clustered
  2. arrangement
     - + opposite
     - + alternate
     - + whorled
  3. sunken
- C. Bud size and shape
- D. Bud type
  1. flower buds
  2. leaf buds
  3. mixed buds
- E. Bud scales
  1. imbricate
  2. valvate
  3. one-scaled
  4. (none) naked
  5. color
  6. pubescence

LESSON 11
Bud Characteristics Useful in Plant Identification in Winter

Objectives

At the end of this lesson, students should be able to

1. discuss the use of buds for winter identification.
2. define terminal buds, lateral buds, and terminal bud scale scars and locate them on twigs.
3. evaluate buds in terms of clustered or solitary, arrangement, size, shape, and type for use in identification.
4. define bud scales and diferentiate among imbricate, valvate, one-scaled, naked, and pubescent bud scales.

Resources/Materials

- slide projector and **slides 222-253**
- overhead projector
- overhead transparencies and/or photocopies of **graphics 11-1, 11-2,** and **11-3**
- photocopies of the evaluation pages - **Bud Review**
- twigs of spring-flowering plant species for forcing, and reference sources on forcing (1)
- cut twigs showing terminal buds, terminal bud scale scars, lateral buds, and lateral bud arrangement (2)
- cut twigs with terminal bud scale scars; also, cut twigs from plants that have suffered stress (to illustrate the differences in twig elongation) (3)
- cut twigs showing bud size and shape; examples of flower, leaf, and mixed buds; examples of imbricate, valvate, and one-scaled buds; naked buds; variations of bud scale color; examples of pubescent buds (4)

Terms to Learn

bud
terminal bud
lateral bud
clustered buds
terminal bud scale scar
bud arrangement
flower bud
leaf bud
mixed bud
bud scales
imbricate
valvate
one-scaled
naked bud
pubescence

Procedures

1. Review material from previous lesson and introduce topic.

2. Show slides 222-239 - **Buds**.

   - Introduction - defining and describing buds and their value in winter identification
   - Terminal buds - defined and illustrated
     - single and clustered terminal buds
     - species lacking true terminal buds
     - terminal bud scale scars
   - Lateral buds - defined and illustrated
     - opposite, alternate, and whorled bud arrangements
     - single and clustered lateral buds
     - sunken lateral buds

3. Have students work with **graphics:** **11-1, Location of Buds**
   11-2, Bud Arrangement

4. Perform Activities 1, 2, and 3, if desired.

5. Show slides 240-253.

   - Bud size and shape
   - Bud type
     - Flower buds
     - Leaf buds
     - Mixed buds

(continued)

Procedures - *continued*

- Bud scales - defined
  - imbricate, valvate, and one-scaled buds
  - naked buds
  - color
  - pubescence

6. Have students work with **graphic 11-3, Bud Scale Characteristics**.

7. Perform Activity 4, if desired.

8. Evaluate student learning.

Activities

1. Try forcing twigs of flowering trees and shrubs for early indoor bloom. Species which can be forced include forsythia, flowering crabapple, Japanese quince, and pussy willow. Check reference sources for details on forcing. Allow students to observe the flowers and leaves emerging from buds.

2. Take students outdoors and have them practice finding and examining terminal buds, terminal bud scale scars, lateral buds, and lateral bud arrangement of various trees and shrubs. Or bring cut twig specimens to class.

3. Have students practice determining the age of branches by examining terminal bud scale scars. Point out that the amount of twig elongation on an individual plant is a good indication of the general health and vigor of the plant. Stressed plants will have less twig growth than will healthy ones.

   Note: Transplanting stresses a plant, reducing the amount of twig elongation for that season. Recovery generally takes more than one year. There will be reduced twig elongation immediately following transplanting and a slightly increased rate the following year. The elongation rate is usually back to normal in another year or two, providing the tree is healthy. By examining twigs, you can often determine the year a plant was transplanted into the landscape.

4. Bring in cut twigs from different plant species for students to examine. Provide hand lenses, if available. Choose twigs that demonstrate the following:
   - differences in bud size
   - differences in bud shape
   - examples of plant species with mixed buds and plant species with separate flower and leaf buds
   - imbricate, valvate, and one-scaled buds; naked buds
   - examples of bud scale color variations
   - examples of pubescent buds

Activities - *continued*

Note: See page 91 for a list of plant species that possess the bud characteristics discussed in this lesson. Only the more common species are included; the list is not meant to be exhaustive or complete.

Evaluation

1. Give students **Bud Review** (pages 89-90). (See Answer Key below.)

2. If you did Activity 2, bring new cut twigs to class and ask students to locate terminal buds, terminal bud scale scars, and lateral buds.

3. If you did Activity 3, give students some cut twigs and have them give the age of the twig.

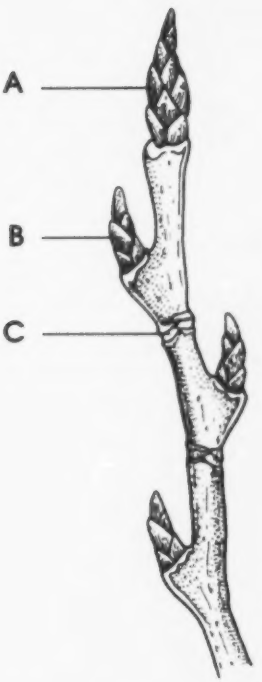
4. If you did Activity 4, bring new cut twigs to class. Have students identify imbricate, valvate, one-scaled buds, naked buds, and pubescent buds.

Answer Key

1.	c
2.	b
3.	d
4.	a
5.	a
6.	a
7.	b
8.	d

NAME _____

Bud Review



Questions 1-6 pertain to the above drawing. Circle the letter of the response that correctly completes the statement.

1. Structure A is a

   a. leaf bud.
   b. lateral bud.
   c. terminal bud.
   d. terminal bud scale scar.

2. Structure B is a

   a. leaf bud.
   b. lateral bud.
   c. terminal bud.
   d. terminal bud scale scar.

3. Structure C is a

   a. flower bud.
   b. lateral bud.
   c. terminal bud.
   d. terminal bud scale scar.

(continued)

4. The bud arrangement shown here is

   a. alternate.
   b. opposite.
   c. sub-opposite.
   d. whorled.

5. In summer, the type of leaf arrangement of this plant would be

   a. alternate.
   b. opposite.
   c. sub-opposite.
   d. whorled.

6. The type of bud scales shown on these buds is

   a. imbricate.
   b. valvate.
   c. one-scaled.
   d. none (no bud scales).

7. Which of the following statements about bud scales is NOT true?

   a. Bud scales protect the inner portions of buds from harsh environmental conditions.
   b. Bud scales may be flower scales, leaf scales, or mixed scales.
   c. The color of bud scales can help identify plants.
   d. Bud scales of some plants are pubescent.

8. Which of the following statements about buds is NOT true?

   a. Inside buds are the structures that will become new stems, leaves, and flowers next spring.
   b. The shape of buds can be used as an identifying tool.
   c. Terminal buds may be single or clustered, depending on the plant species.
   d. Lateral buds always occur in clusters.

9. Explain how buds can be used in tree and shrub identification in the winter.

List of Selected Trees and Shrubs by Bud Characteristics

Bud Arrangement - See "Leaf Arrangement" in *List of Selected Trees and Shrubs by Leaf Characteristics* (page 45)

Species with Separate Flower and Leaf Buds

Eastern redbud *(Cercis canadensis)* and
members of the following genera:
- viburnum *(Viburnum)*
- dogwood *(Cornus)*

Bud Scales

Imbricate
- most maples *(Acer)*
- oak *(Quercus)*
- buckeye and horsechestnut *(Aesculus)*
- beech *(Fagus)*
- serviceberry *(Amelanchier)*
- birch *(Betula)*
- elm *(Ulmus)*

Valvate
- striped maple *(Acer pensylvanicum)*
- tuliptree *(Liriodendron tulipifera)*
- most dogwoods *(Cornus)*
- some viburnums *(Viburnum)*

One-scaled - willow *(Salix)*

Naked - some viburnums *(Viburnum)*

Colored bud scales

The following maples:
- Japanese *(Acer palmatum)*
- red *(A. rubrum)*
- silver *(A. saccharinum)*
- striped *(A. pensylvanicum)*
- Norway *(A. platanoides)*
- boxelder *(A. negundo)*

quaking aspen *(Populus tremuloides)*
sassafras *(Sassafras albidum)*
American sweetgum *(Liquidambar styraciflua)*
tuliptree *(Liriodendron tulipifera)*
sycamore, London planetree *(Platanus)*
linden *(Tilia)*
redbud *(Cercis canadensis)*

(continued)

List of Selected Trees and Shrubs by Bud Characteristics - *continued*

Bud Scales - *continued*

Pubescent bud scales

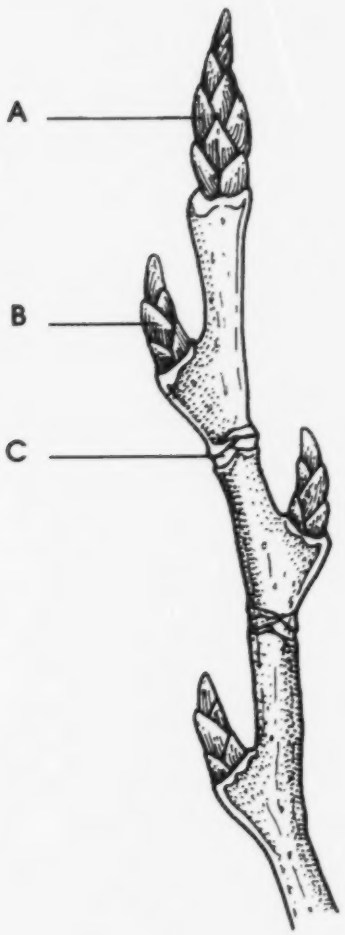
callery pear *(Pyrus calleryana)*
bur oak *(Quercus macrocarpa)*

members of the following genera:
- magnolia *(Magnolia)*
- walnut *(Juglans)*
- sumac *(Rhus)*

100

Graphic 11-1

Location of Buds



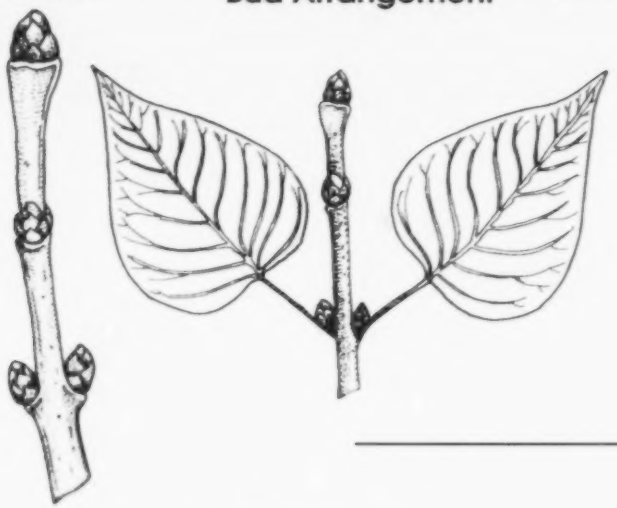
A _____

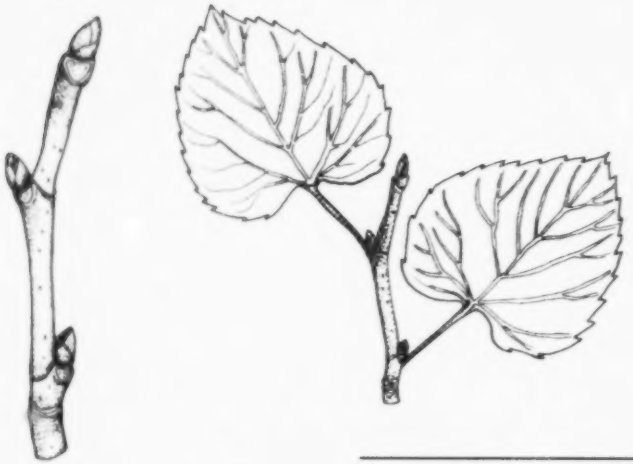
B _____

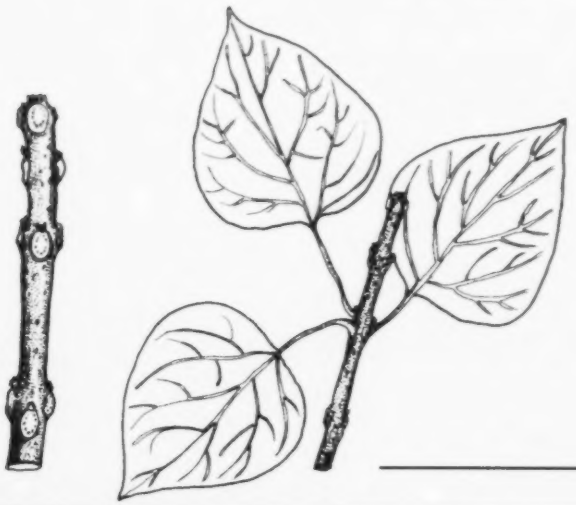
C _____

Graphic 11-2

Bud Arrangement







Graphic 11-3

Bud Scale Characteristics

LESSON 12
Using Year-Round & Winter Identification Characteristics to Identify Plants

Objectives

At the end of this lesson, students should be able to

1. evaluate and identify plants using year-round and winter identification characteristics.
2. consult reference texts as an aid to plant identification.

Resources/Materials

- slide projector and **slides 254-261**
- photocopies of **Year-Round Identification Worksheet** and **Winter Identification Worksheet**
- photocopies of the evaluation pages - **Winter Identification Exam**
- tree and shrub identification guides and books

Procedures

This is the final lesson of the Winter Identification Unit. Students can now use the information studied in the preceding two lessons and in the Year-Round Identification Unit to practice identifying plants. Slides 254-261 demonstrate a holistic approach to identification in which a plant is evaluated for a number of identification characteristics. After you have helped students through the practice identification, have them practice the technique using real plants.

1. Review with students their lists of reasons for the importance of plant identification skills from Lesson 1. Ask if there are any additional reasons to be added to the list. Continue to remind them of the value of plant identification.
2. Review with students the plant identification features discussed in the Year-Round Identification Unit.

(continued)

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Procedures - *continued*

3. Review material from the previous lessons. Tell students they are now ready to practice using year-round identification characteristics and winter identification characteristics to identify unknown plants.

4. Show slides 254-261.

5. Bring to class several tree and shrub identification guides and books. Encourage students to look through them. Use these reference materials for the following exercise.

6. Have students work with the Year-Round Identification Worksheet (pages 37-38) (if this unit has been taught) and the Winter Identification Worksheet (page 103). Divide students into small groups. Assign each group a tree or shrub. Students can complete both worksheets to practice examining a plant for features which are useful in identification. When they have completed the Worksheets, tell each group the name of their plant. Then have them find the plant in a reference book and see how well their findings match the book's description.

   Another approach is to give students a list of plants, which includes the plant to be identified. Have the students use the worksheets and reference texts to determine which plant on the list they are identifying.

7. Evaluate student learning.

Evaluation

1. Give students the **Winter Identification Exam** (pages 99-102), or use the questions for review of the entire unit. (See Answer Key.)

2. Take students to a live tree or shrub. Have students make a list of characteristics of that plant that can be used to identify it. Their responses should include descriptions of such year-round identification traits as size, shape, trunk habit, texture, bark features, and stem characteristics, and such winter identification traits as persistent leaves, flower structures, persistent fruit, and buds.

Answer Key

1.	b
2.	c
3.	c
4.	b
5.	a
6.	c
7.	b
8.	a
9.	c
10.	b
11.	d
12.	b
13.	a
14.	c

NAME _____

Winter Identification Exam

Circle the letter of the response that best answers the question or completes the statement. *(6 points each)*

1. Which of the following plant parts is NOT useful in identifying deciduous trees and shrubs during the winter?

   a. Acorn cups
   b. Compound leaves
   c. Flower structures
   d. Fruit

2. A **catkin** is a

   a. type of dry fruit.
   b. type of fleshy fruit.
   c. type of flower structure.
   d. cluster of lateral buds on a stem.

3. Which group of deciduous trees frequently retains some dead leaves through the winter?

   a. Ashes
   b. Maples
   c. Oaks
   d. Pines

4. Which of the following statements is TRUE?

   a. Fleshy fruits freeze and persist through the winter.
   b. Fleshy fruits, often eaten by wildlife, may not persist through the winter.
   c. Dry fruits always persist through the winter.
   d. Capsules are a type of fleshy fruit.

5. **Pubescent** bud scales are those that

   a. are covered with hair-like structures.
   b. are clustered.
   c. are sunken into the stem.
   d. overlap like shingles on a roof.

6. Which of the following statements about buds is TRUE?

   a. Buds do not vary in size from one plant species to another.
   b. Terminal buds always occur singly.
   c. Bud scales can vary in color, depending on the plant species.
   d. Plants with alternate bud arrangement sometimes have a whorled leaf arrangement.

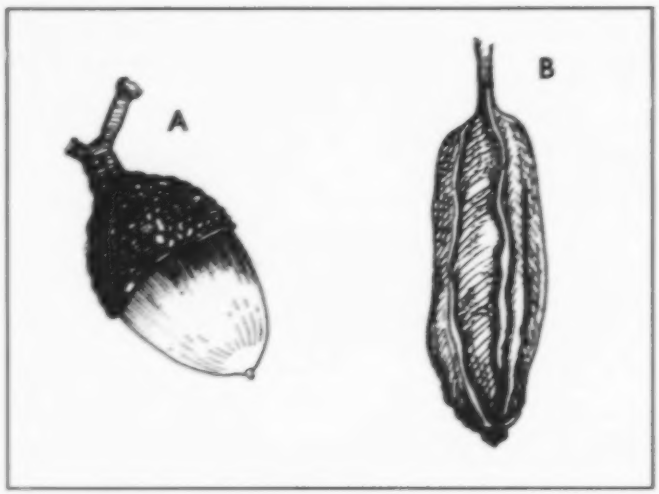
(continued)

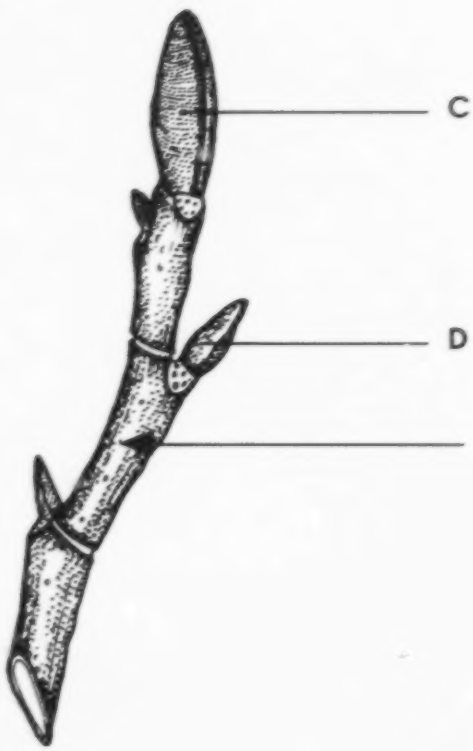
7. Structure A is a

   a. catkin.
   b. dry fruit.
   c. fleshy fruit.
   d. pod.

8. Structure B is a

   a. capsule.
   b. catkin.
   c. fleshy fruit.
   d. pod.





Refer to the above drawing of a stem to answer questions 9-14.

(continued)

9. Structure C is a

   a. naked bud.
   b. lateral bud.
   c. terminal bud.
   d. terminal bud scale scar.

10. Structure D is a

    a. naked bud.
    b. lateral bud.
    c. terminal bud.
    d. terminal bud scale scar.

11. For the plant parts it contains, structure D is known as

    a. a leaf bud.
    b. a flower bud.
    c. a mixed bud.
    d. an unknown bud type (as not enough information is given).

12. What type of bud scale does structure D possess?

    a. Imbricate
    b. Valvate
    c. One-scaled
    d. None; it is a naked bud

13. How are the lateral buds arranged?

    a. Alternate
    b. Opposite
    c. Sub-opposite
    d. Whorled

14. The section of the stem that the arrow is pointing to is _____ old.

    a. six months
    b. one year
    c. two years
    d. three years

(continued)

15. Why is it important to be able to identify plants in the winter? *(7 points)*

16. List three ways that you will be able to use plant identification skills in the future. *(9 points)*

NAME _____

WINTER IDENTIFICATION WORKSHEET

General Observations

1. Are any leaves still attached to the plant? _____

   If "yes," describe their appearance. _____

   _____

2. Are any flowering structures, such as catkins, present? _____

   If "yes," describe their appearance. _____

   _____

3. Are persistent fruit present? _____

   If "yes," are fruit fleshy or dry? _____

   Describe the fruit. _____

   _____

Bud Characteristics

4. Does the plant have one terminal bud or several? _____

5. Is there one lateral bud per site on the stem, or are several clustered together?

   _____

   Are lateral buds arranged in opposite, alternate, or whorled arrangement?

   _____

6. Describe the size and shape of the buds. _____

   _____

7. Are the buds imbricate, valvate, one-scaled, or naked? _____

   What color are the bud scales? _____

   Are the bud scales pubescent? _____

This plant is _____

GLOSSARY

acorn	the fruit of oaks - a dry fruit
acorn cup (or cap)	woody structure at the base of an acorn
alternate arrangement	buds or leaves growing in an alternating or spiraling pattern along the stem.
bipinnate	compound leaf arrangement with leaflets attached to one leaf stalk, which in turn is attached to a main leaf stalk; twice branched.
bud	small structure on a stem that contains plant parts that will form new stems, leaves, and/or flowers when growth begins in spring.
bud arrangement	placement of buds along the stem in an opposite, alternate, or whorled pattern.
bud scales	scales that cover and help protect a bud from unfavorable environmental conditions, such as cold temperatures.
capsule	one type of dry fruit that breaks open when ripe, releasing the seeds
catkin	type of flower structure usually spike-like and often pendulous (hanging down); contains many tiny flowers, which are usually of the same sex; typical of birches.
clustered buds	more than one lateral bud or terminal bud at the same site on the stem.
columnar growth habit	plant shape that is upright, tall, and narrow
compound leaf	a leaf that is composed of several leaflets above a bud.
deciduous	with leaves dying and usually dropping in the fall
dioecious	plant species that produces male flowers on one plant and female flowers on a separate plant.
dry fruit	fruit that are dry to the touch; usually tan or brown when ripe.
entire leaf margin	leaf edge that is smooth with no teeth or indentations
evergreen	with green foliage throughout the year

(continued)

exfoliate	peeling off in shreds or thin strips
female flower	flower containing only pistils
fleshy fruit	fruit with flesh-like tissue (which can be either hard or soft) surrounding the seed; fruit often colorful and ornamental.
flower buds	buds containing structures that will become flowers when growth begins in spring.
flower cluster	many small flowers bunched together.
fruit	plant reproductive structure which contains seeds.
imbricate	scales on a bud overlapping like shingles on a roof.
lateral bud	bud growing on the side of a twig.
leaf arrangement	placement of leaves along the stem in an opposite, alternate, or whorled arrangement.
leaf base	bottom end of a leaf
leaf buds	buds containing structures that will become leaves when growth begins in spring.
leaf margin	outer edge of a leaf
leaf petiole	stalk-like structure which attaches the leaf blade to the stem.
leaf scar	mark left at the former attachment point of a leaf to the twig.
leaf veins	lines running through a leaf
leaflet	individual "leaf" of a compound leaf
lenticel	small corky spot or dot found on some plant stems and bark.
lobed leaf margin	the edge of a leaf that is deeply cut, forming lobes
male flower	flower containing only stamens
mixed buds	buds containing structures that will become both leaves and flowers when growth begins in the spring.
monoecious	plant species that produces both male and female flowers on the same plant.
naked bud	bud with no bud scales or protective covering

nut	dry fruit typically partly or entirely surrounded by a husk.
one-scaled	a single cap-like scale that entirely covers the bud
opposite arrangement	buds or leaves growing across the stem from each other
oval growth habit	plant shape that is oval in appearance
palmate	compound leaf arrangement with leaflets attached at one point on the end of the leaf stalk.
persistent	plant parts such as leaves and fruit that remain on a plant for a long time rather than dropping off.
petal	part of the flower that is often conspicuous and showy
pinnate	compound leaf arrangement with leaflets attached along each side of the leaf stalk.
pistil	female part of the flower that eventually produces seed
pith	central core of a twig
pod	type of dry fruit usually long and narrow in shape that splits open when ripe, releasing seeds; examples - beans and peas.
pubescence	small hair-like structures sometimes found on leaves, stems, fruit, or buds.
pyramidal growth habit	plant shape that is triangular in appearance
rounded growth habit	plant shape that is round in appearance
samara	type of dry fruit that has one or two wing-like attachments; example - maples.
sepal	usually green and leafy part of the flower typically located beneath the petals.
simple leaf	a single leaf present above the bud
solitary flower	flower type with only one flower borne at the end of the flower stalk.
stamen	male part of the flower that produces pollen
stipules	pair of small leaf-like structures at the base of the leaf petiole

(continued)

terminal bud	bud at the end or tip of a twig
terminal bud scale scar	scar left on the twig by the terminal bud of the previous season; useful in determining age of a twig.
texture	the coarse or fine appearance of branches, twigs, and leaves.
toothed leaf margin	the edge of a leaf that is jagged with teeth-like indentations.
trunk habit	the branching characteristics of a tree trunk; single or multiple trunks.
valvate	bud scales that meet exactly with no overlap
variegated	leaves of two or more colors, such as green and white
vase-shaped growth habit	plant shape that is narrow at the base and wide at the top
wavy leaf margin	the edge of a leaf that is wavy in appearance
weeping growth habit	plant shape with branches hanging down towards the ground
whorled arrangement	buds or leaves growing in groups of three or more, located near each other around the stem.

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